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Technology Review

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THE LIGHT
OF THE
SUPERNOVAE

technology review

Published by MIT

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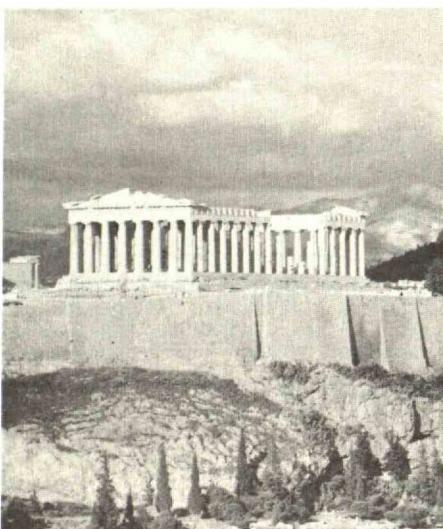


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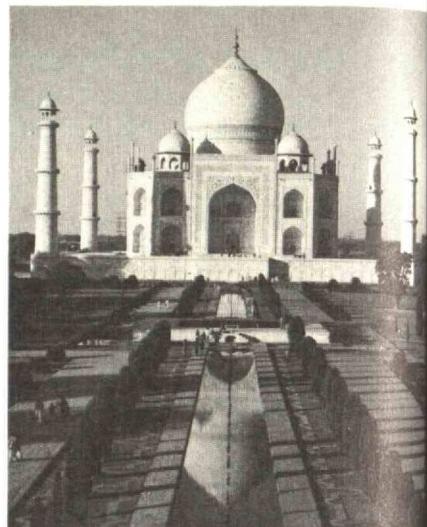


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PATMOS and SANTORINI. Total cost is \$1875 from New York. Departures in April, May, July, August, September and October 1975 (extra air fare for departures in July and August).



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An unusual opportunity to view the outstanding attractions of India and the splendor of ancient Persia, together with the once forbidden mountain-kingdom of Nepal. Here truly an exciting adventure: India's ancient monuments in DELHI; the fabled beauty of KASHMIR amid the snow-clad Himalayas; the holy city of BANARAS on the sacred River Ganges; the exotic temples of KHAJURAO; renowned AGRA, with the Taj Mahal and other celebrated monuments of the Moghul period such as the Agra Fort and the fabulous desert city of Fatehpur Sikri; the walled "pink city" of JAIPUR, with an elephant ride at the Amber Fort; the unique and beautiful "lake city" of UDAIPUR; and a thrilling flight into the Himalayas to KATHMANDU, capital of NEPAL, where ancient palaces and temples abound in a land still relatively untouched by modern civilization. In PERSIA (Iran), the visit will include the great 5th century B.C. capital of Darius and Xerxes at PERSEPOLIS; the fabled Persian Renaissance city of ISFAHAN with its palaces, gardens, bazaar and famous tiled mosques; and the modern capital of TEHERAN. Outstanding accommodations include hotels that once were palaces of Maharajas. Total cost is \$2295 from New York. Departures in January, February, March, August, September, October and November 1975.

SOUTH AMERICA

32 DAYS \$2325

From the towering peaks of the Andes to the vast interior reaches of the Amazon jungle, this tour travels more than ten thousand miles to explore the immense and fascinating continent of South America: a brilliant collection of pre-Colombian gold and a vast underground cathedral carved out of a centuries-old salt mine in BOGOTA; magnificent 16th century churches and quaint Spanish colonial buildings in QUITO, with a drive past the snow-capped



peaks of "Volcano Alley" to visit an Indian market; the great viceregal city of LIMA, founded by Pizarro, where one can still see Pizarro's mummy and visit the dread Court of the Inquisition; the ancient city of CUZCO, high in the Andes, with an excursion to the so-called "lost city" of MACHU PICCHU; cosmopolitan BUENOS AIRES, with its wide streets and parks and its colorful waterfront district along the River Plate; the beautiful Argentine LAKE DISTRICT in the lower reaches of the Andes; the spectacular IGUASSU FALLS, on the mighty Parana River; the sun-drenched beaches, stunning mountains and magnificent harbor of RIO DE JANEIRO (considered by many the most beautiful city in the world); the ultra-modern new city of BRAZILIA; and the fascination of the vast Amazon jungle, a thousand miles up river at MANASUS. Total cost is \$2325 from Miami, with special rates from other cities. Optional pre and post tour visits to Panama and Venezuela are available at no additional air fare. Departures in January, February, April, May, July, September, October and November 1975.

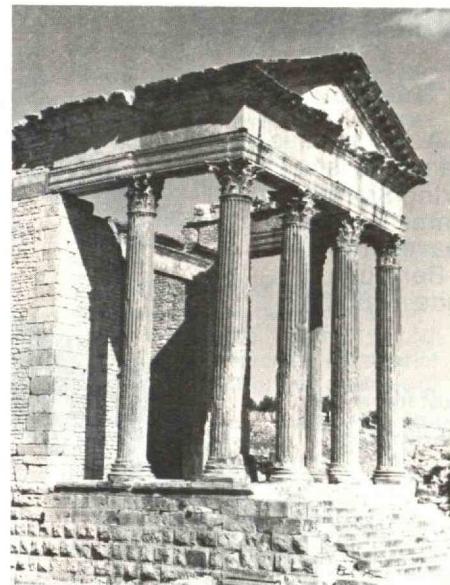


THE SOUTH PACIFIC

29 DAYS \$2685

An exceptional and comprehensive tour of AUSTRALIA and NEW ZEALAND, with optional visits to FIJI and TAHITI. Starting on the North Island of New Zealand, you will visit the country's major city of AUCKLAND, the breathtaking "Glowworm Grotto" at WAITOMO, and the Maori villages, boiling geysers and trout pools of ROTORUA, then fly to New Zealand's South Island to explore the startling beauty of the snow-capped SOUTHERN ALPS, including a flight in a specially-equipped ski plane to land on the Tasman Glacier, followed by the mountains and lakes of QUEENSTOWN with a visit to a sheep

station and a thrilling jet-boat ride through the canyons of the Shotover River. Next, the haunting beauty of the fiords at MILFORD SOUND and TE ANAU, followed by the English charm of CHRISTCHURCH, garden city of the southern hemisphere. Then it's on to Australia, the exciting and vibrant continent where the spirit of the "old west" combines with skyscrapers of the 20th century. You'll see the lovely capital of CANBERRA, seek out the Victorian elegance of MELBOURNE, then fly over the vast desert into the interior and the real OUTBACK country to ALICE SPRINGS, where the ranches are so widely separated that school classes are conducted by radio, then explore the undersea wonders of the GREAT BARRIER REEF at CAIRNS, followed by a visit to SYDNEY, magnificently set on one of the world's most beautiful harbors, to feel the dynamic forces which are pushing Australia ahead. Optional visits to Fiji and Tahiti are available. Total cost is \$2685 from California. Departures in January, February, March, April, June, July, September, October and November 1975.



MEDITERRANEAN ODYSSEY

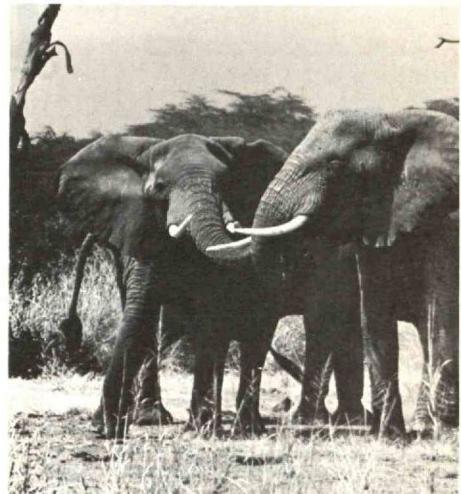
22 DAYS \$1695

An unusual tour offering a wealth of treasures in the region of the Mediterranean, with visits to TUNISIA, the DALMATIAN COAST of YUGOSLAVIA and MALTA. Starting in TUNIS, the tour explores the coast and interior of Tunisia: the ruins of the famed ancient city of CARTHAGE as well as the ruins of extensive Roman cities such as DOUGGA, SBEITLA, THUBURBO MAJUS and the magnificent amphitheater of EL DJEM, historic Arab towns and cities such as NABEUL, HAMMAMET, SOUSSE and KAIROUAN, the caves of the troglodytes at MATMATA, beautiful beaches along the Mediterranean coast and on the "Isle of the Lotus Eaters" at DJERBA, and desert oases at GABES, TOZEUR and NEFTA. The beautiful DALMATIAN COAST of Yugoslavia is represented by SPLIT, with its famed Palace of Diocletian, the charming ancient town of TROGIR nearby, and the splendid medieval walled city of DUBROVNIK, followed by MALTA, with its treasure house of 17th and 18th century churches and palaces, where the Knights of St. John, driven from the Holy Land and from Rhodes, withstood the epic siege of the Turks and helped to decide the fate of Europe. Total cost is \$1695 from New York. Departures in March, April, May, June, July, September and October, 1975 (additional air fare for departures in June and July).

EAST AFRICA

23 DAYS \$2100

An exciting, unforgettable luxury safari which covers East Africa from the wilderness of the interior to the tropics of the coast on the Indian Ocean: game viewing in the semi-desert of Kenya's Northern Frontier district at SAMBURU RESERVE; a night at world-famous TREETOPS in the ABERDARE NATIONAL



PARK; the spectacular masses of pink flamingos at LAKE NAKURU; black-maned lions and multitudes of plains game in MASAI-MARA RESERVE; the vast stretches of the SERENGETI PLAINS, with leopard, cheetah and large prides of lions, as well as great herds of zebra, wildebeest, and impala; the permanent concentrations of wildlife on the floor of the NGORONGORO CRATER; tree-climbing lions and herds of elephant along the shores of LAKE MANYARA; and the beaches and tropical splendor of historic MOMBASA on the Indian Ocean, with its colorful old Arab quarter and great 16th century Portuguese fort, and with optional excursions to LAMU or ZANZIBAR. The program also includes a visit to the famous excavations at OLDUVAI GORGE and special opportunities to see tribal dancing and the way of life of the Kikuyu and Masai tribes, as well as the great safari capital of NAIROBI. Optional post-tour extensions are also available to ETHIOPIA and the VICTORIA FALLS. Total cost is \$2100 from New York. Departures in January, February, March, May, June, July, August, September, October, November and December 1975.

* * *

Rates include Jet Air, Deluxe Hotels, Most Meals, Sightseeing, Transfers, Tips and Taxes.

Individual brochures on each tour are available, setting forth the detailed itinerary, departure dates, hotels used, and other relevant information. Departure dates for 1976 are also available.

For Full Details Contact:

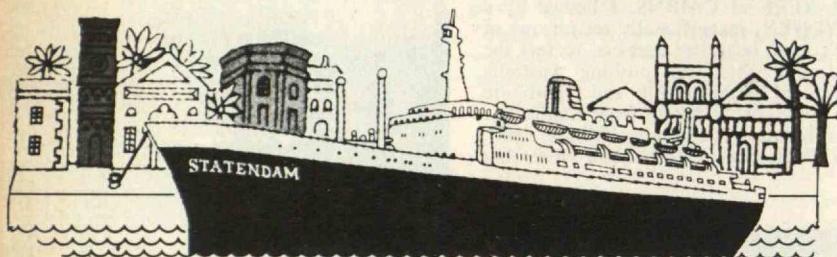
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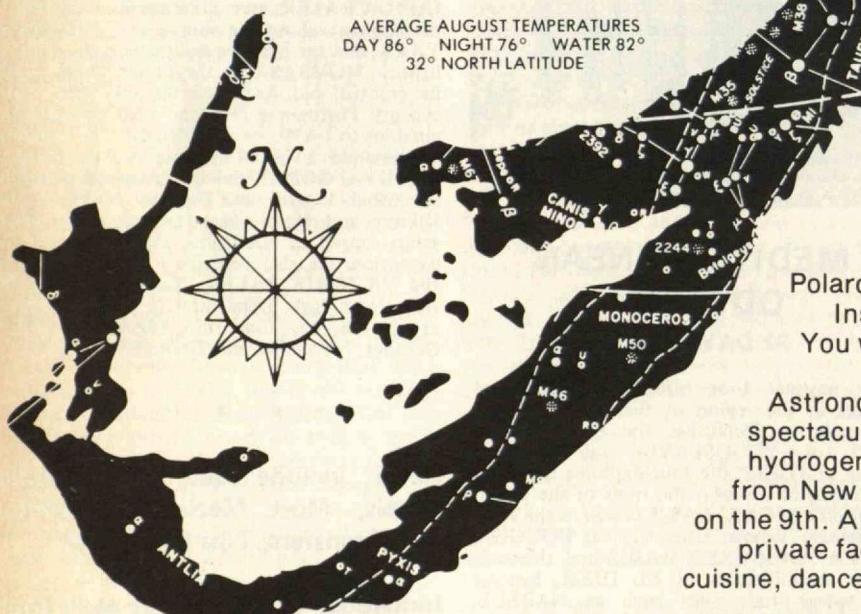
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Technology Review



Articles

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The Light of the Supernovae

Philip Morrison

The explosion of a star is the ultimate stellar event, far larger and more efficient conversion of energy than any we know on earth or in the sun. But to comprehend this event we can work only with what we see

Using Rock Physics to Search for Petroleum

Nafi Toksoz

Our understanding of the physical properties of rocks has vastly advanced in a decade, and from this advance comes the promise of powerful new ways of locating new reserves of oil and gas

New Techniques in Geophysical Exploration for Minerals

David W. Strangway

We are on the threshold of major improvements in geophysical exploration — and therefore of the first accurate inventory of the world's minable mineral deposits

The Federal Energy Office as Regulator of the Energy Crisis

Paul W. MacAvoy, Bruce E. Stangle, and Jonathan B. Tepper

Federal management of petroleum supply and distribution during the O.P.E.C. nations' embargo served not to regularize the market but to exacerbate shortages

Lessons from 1929 for the Petro-Dollar Problems

Charles P. Kindleberger

The international good depends upon the leadership of one power which puts the goal of economic stability above short-range self-interest. As the petro-dollar problem deepens, what nation will assume this role?

Departments

Cover

The supernova in Galaxy NGC 5457 is shown by the red dot (photo: Mt. Wilson and Palomar Observatories)

The First Line

4

Letters

4

Environment/Technology

Used for one purpose, DDT turns out to have subtle and far-reaching effects on a wide range of unrelated objects
Ian C. T. Nisbet

Special Report

Notes on the achievement of a tolerable planet in an age of high technology
Stuart Chase

Technology/Society

Improving our methods of evaluating large systems should have a high priority among today's social science research goals
Kenneth E. Boulding

Books

Handbook of Marketing and Marketing Research: Analysis and Measurement, reviewed by Gary L. Lilien, 14

38 *Zen and the Art of Motorcycle Maintenance: An Inquiry into Values*, reviewed by Deborah McGill, 15

The Creative Ordeal, reviewed by Frederick G. Fassett, Jr., 16

Cities of Vision and Close-up: How to Read the American City, reviewed by Ralph Warburton, 17

Trend of Affairs

46 Architecture, 57
Medicine, 57
Weather, 60
Environment, 61
Computers, 63
Working Women, 64

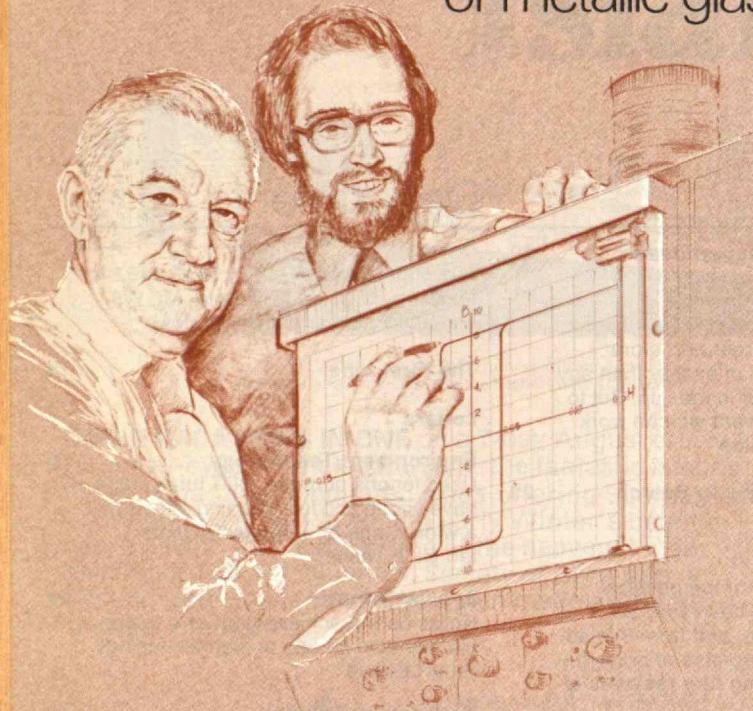
Puzzle Corner

A rhumb line flight and the saga of a captured pirate
Allan J. Gottlieb

Institute Informant

A chronicle of recent events at and affecting the Massachusetts Institute of Technology

On the easy magnetization of metallic glasses.



Ribbons and wires made of ferrous metallic glasses can be fully magnetized by applied fields of less than one Oersted and demagnetized by fields of several milli-Oersteds. Indeed the earth's field can magnetize and demagnetize them. These METGLAS™ materials are typically composed of 80% transition metals (Fe, Co, Ni, etc.) and 20% metalloids (P, B, Si, etc.). They are quenched very rapidly from the liquid state (rates of about 10^6 °K/sec) to retain the amorphous liquid structure.

Ribbons of one alloy show the following properties under moderate tensile stress: coercive force = 0.007 Oe; induction at 1 Oe = 7800G; maximum permeability = 10^6 ; loop squareness = 0.99. For other compositions, the saturation magnetization ranges from 8 to 15,000G. The electrical resistivities are about 3X larger than for crystalline Fe-Ni alloys.

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The First Line

Dick, Jane, and Werner von Braun

We recently received from a former elementary school teacher, Eve R. Wirth, a collection of comments on the engineering profession — her students' reactions collected during a career of teaching eight-to-ten-years-olds. They piqued our fancy — and we'd like to share them with you:

"There are many different kinds of engineers, like electrical, chemical, and even civilized engineers."

"I'm not too certain what a bridge engineer is supposed to do, but trying to find out is my biggest daily constant doing."

"The sanitary engineers are the cleanest of all engineers — or would like to be."

"One day I hope to be a famous engineer and do it in my city's outer skirts, because that's where all the action is, if you know what I mean."

"Engineers really have to know what they are doing. They can't be nervous or nutty — their work is a serious business. One wrong move and it could mean phooft-in-the-pipes."

"I had been so glad when I thought in my thoughts that I would only have to go to college for four years to become an engineer. Then one sudden day, I learned the hard truth that I was wrong and all the happiness in my heart went 'zoom' out of my thoughts, but that's the way it is when you're only a child."

"A computer has five parts — input, output, and the rest is memory which I forgot."

"Oscillators are things that only encyclopedias know for certain about."

"The meaning of sextant is something I can't write about."

"An electron is a charge. It might be elementary or senior. I'm not too sure. It takes all of my remembering to even remember that an electron is a charge."

"I want to be an engineer when I grow up. Tell me just how good I have to be in math, because if I have to be real good, don't count on me coming. Good-bye."
—J.M.

Letters

Seaport Specialization?

I do not doubt, as Ernst G. Frankel argues (December, 1974, p. 66) that better regional and national planning of port facilities is desirable — even urgently necessary. I do doubt, however, that an unconstrained efficiency principle is a sufficient criterion for determining the scale, location or service spectrum of such facilities.

Though I am not qualified as an expert in transportation, I would still disagree with Professor Frankel that "ports are nothing but a terminal interface. . . ." Ports are a good deal more than that,

and even if they were just that, they would still be subject to the same trade-off considerations that apply to the pervasive question of how specialized a machine, plant or community should be. The very planning process for which he argues so convincingly would be the first to introduce such concerns.

Robert C. Cauthorn
Tucson, Ariz.

Professor Frankel responds:

In a world of diminishing resources, including waterfront land, access channels, etc., the traditional laissez-faire of independent locally controlled and owned port authorities results in tremendous waste, vast overcapacity, exorbitant (pork barrel) drain of federal resources for unnecessary channel dredging and resulting inefficient use of overcapacitated inland or other domestic transport. I simply maintain that more cooperation and regional planning of port facilities is required if we are to maintain a reasonable balance between production and transport/distribution costs.

Evolution: Disaster Never Complete

Kenneth E. Boulding's central theme in "Imagining Failure Successfully" (June, 1974, p. 8) is that "nothing fails like success," although he puts it in a modern evolutionary setting. It is the central paradox of all existence and was no doubt in the minds of men when mankind first began to speculate.

Dr. Boulding writes that "adaptation leads to a loss of adaptability" which "eventually leads to disaster. We learn about the cliff by falling over it," he says. In Sophocles' play, King Oedipus can be said to have successfully adapted; he answered the question of the Sphinx and thereby saved the city of Thebes from its depredations. He was a good king, a good husband, and a good father; but, having adapted, he did not see the possibility of disaster.

The moral of the play is that, although Oedipus destroyed himself socially and politically, he himself was not destroyed as an individual. A similar moral may be drawn in the evolutionary process: although there are failures in some aspects of evolution, the life process itself is not destroyed.

Silvio Zanetti
Cambridge, Mass.

Politics and Medicine

Victor Cohn's report for December, 1974 ("Science Comes to Medicine - Slowly," pp. 8-9) clearly conveys his political bias (and that of the *Washington Post*) in a manner which, to me at least, is offensive. It also is not pertinent to his theme or necessary to support it.

Technology Review should do better than this.

John Gillespie
Jackson, Mich.

A Biblical Monoculture

Like Kenneth Boulding ("Plains of Science, Summits of Passion," December, 1974, p. 6), I have lived on the "uneasy margin between science and religion." And as I was meditating on the central thought of Dr. Boulding's essay — the danger of monoculture — I was reminded of the Biblical story of the Tower of Babel: here was a monoculture; everybody seemed to be living in peace and harmony.

Why did Divine Providence seek to destroy Babel? Dr. Boulding's essay is a fitting commentary and explanation.

Samson Eichler
Philadelphia, Pa.

Overoptimism on Drying Books

Because the tone of "Put Wet Books in a Microwave Oven" (January, p. 61) implies that the process is fully tested and operational, we want to make the following clarifications:

— The studies to date have demonstrated the feasibility of using microwave energy to dry water-soaked books; at the least, further studies should be conducted before committing rare books or manuscripts to this drying procedure.

— "Exposures of only a few minutes" did not suffice for completely drying a wet book, but did allow the damp pages to be handled with substantially decreased danger of tearing.

— "Overdrying," as such, is not a problem — but rather uneven drying of a bound book which results in localized areas of high moisture content, leading to the development of high temperatures and possible resultant charring. Single pages and book signatures, dried separately, undergo more uniform drying and did not discolor.

— We did not dry frozen books. It is our hope that by rapid drying with microwave heating, we may be able to avoid the need for freezing. Continuing studies, however, are investigating the drying of frozen books with microwave energy input.

James M. Flink Denise Thomas
Cambridge, Mass. Newark, Del.

Dr. Flink is Assistant Professor of Food Engineering at M.I.T.; Ms. Thomas, who was formerly associated with the Department of Nutrition and Food Science at M.I.T., is now a student in the Winterthur Program in the Conservation of Artistic and Historic Objects of the University of Delaware. — Ed.

Electricity Down On the Farm

Gary H. Heichel ("Energy Needs and Food Yields," July/August, 1974, pp. 18-25) compares the electrical energy delivered to the farmer with other forms of energy input and concludes that energy consumed in the form of fuel for machines constitutes the largest single input. His figures show that the farmer's use of fuel is greater than his use of electricity by a

factor of two or more, but this comparison ignores the true energy cost of electricity.

Because of the materials limitations on high-temperature machinery, modern power generation plants achieve a conversion efficiency of about 30 per cent. This means that only one-third of the chemical energy in coal or oil can be recovered as electricity. Thus the real energy use in the "electricity" category of Dr. Heichel's comparison is three times larger than he has shown. This makes electrical energy, not fuel, the largest single energy input in American agriculture.

Bruce D. Pomeroy
Schenectady, N.Y.

Science in Evolution

Laurence M. Gould ("Science in Our Seamless Web," January, p. 9) looks at science and society as a 20th-century Western scientist. But contrary to his mores, science did not begin with Francis Bacon 300 years ago nor evolve because "... man is curious and relatively intelligent." Science evolved as a chance by-product of our evolution — a by-product which began with the introduction of agriculture 10,000 years ago.

A primitive agriculture reflected a simple culture. Today, Western science reflects a complex culture — a superorganic structure evolved far beyond anyone's ability to understand it, a culture and a science that cannot be described in terms of "cause" and "effect." There are not just two or a few, but many factors involved in evolution, factors that are characteristically random and too complex to be simplistically described.

Our past is the result of randomness. Our future will be the same. We are irrevocably locked into evolution: a one-way street with no "U-turns" and no "off-ramps." We have no choice in the matter: evolution will continue with or without our cultural mores. And contrary to Dr. Gould, we are not distinct from the millions of species that have been rendered extinct in the evolutionary process. We have just as much chance for extinction as another species. It does not matter whether we can realize what will destroy us in the future. We are not "the master of our fate, the captain of our ship"; evolution is.

Ted Mahr
Olympia, Wash.

The writer is a student at Evergreen State College, Olympia. — Ed.

You Auto Consider Cars

Although mass transit systems are desperately needed in parts of our country, superficial analysis of these needs does not enhance the success of mass transit. If I interpret Peter Goldmark's concepts correctly ("You Gonna Get em Down on the Farm?" January, page 53), communications may become a viable al-

ternate to transporting people into congested areas to their jobs. This in effect will reduce the need to develop costly mass transit systems and not the reverse as suggested in "Computing the Commuter," on the next page of the same issue.

Presumably, within Goldmark's scenario, the free-ranging personal vehicle (auto, or something like it) would still remain the choice for random movement in rural areas for shopping, social calls, and "psychological escape from cabin fever" as mass transit would be unsuited to these needs.

F. J. Kovac
Akron, Ohio

The writer is Chairman of the Advanced Concept Steering Committee of Goodyear Tire and Rubber Co. — Ed.

The Parts Compose the Hole

In a magazine as excellent as *Technology Review*, it is disappointing to find a grievous error in word usage, no matter how common this error may be in lesser media. I am referring to the unfortunate phrase "is comprised of" (see "The Reading Machine's 'Voice,'" December, 1974, pp. 67-68), which always is used where "is composed of" conveys the intended meaning, as if "comprise" were some classier synonym for "compose," which it is not.

The words "comprise" and "compose" bear a relationship somewhat similar to that between "imply" and "infer" — of which I trust you are fully aware. The parts compose the whole, and the whole comprises — or is composed of — the totality of the parts. The whole includes any or all of the parts, and thus the word "include" is less specific than "comprise" but otherwise a near-synonym. Surely no one would say "is included of," since that is nonsense, and "is comprised of" is no better.

U. L. Upson
Richland, Wash.

Evaluating the Breeder Reactor: Externalities Cannot Be Ignored

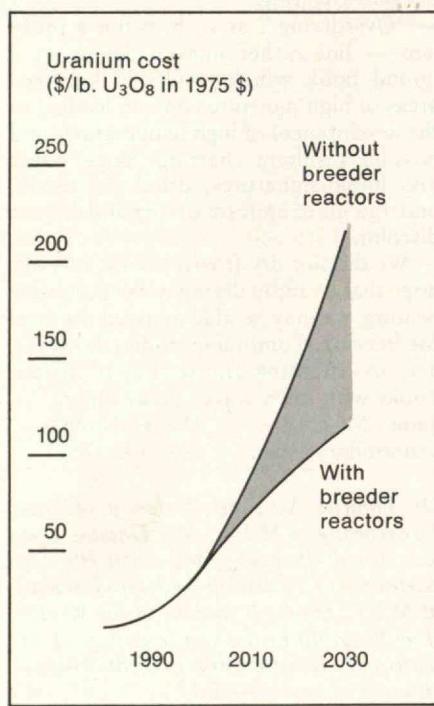
After examining the economics of nuclear power and the liquid metal fast breeder reactor (LMFBR), Irvin C. Bupp and Jean-Claude Derian ("The Breeder Reactor in the U.S.: A New Economic Analysis," July/August, 1974, pp. 26-37) conclude that the development of breeders in the U.S. cannot be justified. We do not agree.

The fundamental issue is the long-term cost and availability of high-grade uranium. Reactors now being ordered for start-up in the early 1980s will have useful lives extending into the second decade of the 21st century. It now appears that some time around the turn of the century we may be forced to turn to uranium from low-grade ores whose energy content is comparable to that of coal for use in the reactors which are now being ordered and

built. The most recent estimate of uranium (U_3O_8) recovery cost from low-grade uranium ores such as the Tennessee shales containing 70 p.p.m. of uranium is \$126/lb. by the sulfuric acid leaching method or \$158/lb. for the oxygen pressure-leaching method. Neither method has yet been tested at the pilot plant level.

The scale of operations which would be required is impressive. With ore containing only 70 p.p.m. of uranium and with a recovery rate of 70 per cent, the production of 150,000 tons of U_3O_8 per year (the projected level for the year 2000) would require annually mining over 3 billion tons of low-grade uranium ores; this is more than five times the bituminous coal mining in the U.S. in 1973. The environmental burden would be significant: the shale operation would be concentrated in principally one state — Tennessee — whereas coal mining activity today is widely distributed. Sulfuric acid consumption would be 180 million tons/yr. — six times the current U.S. production rate. The volume of the spent shale would be some 80 per cent greater than that of the virgin shale, so that it could not all be disposed of in the depleted mine.

Compare this with the uranium requirements of the breeder: if all of the new U.S. generating capacity from now to the year 2010 were provided by new



The shaded area represents the difference in the cost of uranium in the years after 2000 in an energy economy with and without breeder reactors, according to Thomas R. Stauffer and others (see letter). The breeder would produce an "externality," they say, which will accrue to conventional reactors because of the uranium which will come from breeder reactors as a by-product of power generation.

breeders, their entire uranium supply could be furnished by the depleted uranium tailings already existing above ground at the Oak Ridge enrichment plants.

It is possible, of course, that an environmentally acceptable means of extracting U_3O_8 from low-grade ores can be developed or that significant new high-grade ore deposits will be discovered. But the fact is that no new major uranium-producing areas or potential producing areas have been identified in the U.S. during the last 15 years. It is possible that more high-grade ores will be found, but if electrical and nuclear energy's share continues to grow, then a new discovery that doubles our low-cost reserves will postpone the inevitable by only a few years or at most a decade.

The benefits of the breeder reactor relative to light water reactors (LWRs) are often underestimated from an economics point of view. They can be divided into two categories:

— *Internal benefits* — the savings in lifetime fuel cycle costs due to the breeder's more efficient use of uranium resources, less the effects of higher capital costs, more costly fuel processing and fabrication, and higher operating charges. This is the benefit most frequently discussed because it would be realized by a utility purchasing an LMFBR rather than an LWR or fossil plant. This first benefit is a direct financial savings. The second benefit is indirect:

— *External benefits* — the reduced fuel costs enjoyed by all LWRs because the introduction of breeder reactors slows or in the long term eliminates the increases in uranium costs due to the irreversible depletion of less expensive resources. These benefits, externalities, can be very large. Their magnitude is sensitive to the timing and size of the breeder reactor program, the mix between fossil and nuclear electricity generation, and the actual cost trends for uranium.

Simulation studies reveal that the external benefit can be as large as the internal. This is the major source of discrepancy between cost-benefit analyses of the breeder program taken *in toto* and cost-comparisons of single pairs of reactors. The externality is automatically included in any computation of the costs and benefits of a full program including LWRs and breeders, whereas it is not revealed by the simpler calculations which compare a single breeder with a single LWR.

Much of the ultimate benefit from breeders will accrue to operators of light-water reactors, to be experienced indirectly as lower fuel costs over the full lifetime of the light water reactors. However, in such measure as a breeder program reduces LWR fuel costs, it narrows the *pro forma* advantage of a breeder over an LWR, and it also reduces the incentive for individual utility managements to

build breeders. Yet if enough breeders were not built, the fuel cycle savings which potentially could be enjoyed by all, would be foregone. This would be an irreversible economic loss to society, since sizeable extra economic resources would have been spent in mining unnecessarily low grades of uranium.

Many key parameters in simulation studies of nuclear power are subject to uncertainty at the present time. In the following example, we have chosen mid-range values to illustrate the importance of the externality instead of undertaking a definitive computation of the benefits of the breeder. However, since uranium costs are so central to this discussion, we have used two different estimates of uranium availability: the proved plus "reasonably assured" reserves as reported by the Atomic Energy Commission, and an arbitrary doubling of the size of the reserves in each cost category.

In our results (*chart*), the difference between the actual uranium costs with and without breeder reactors measures the "externality" which accrues to LWRs from the reduced uranium demand and the less rapid depletion of lower-cost deposits. This benefit would not be reflected in any utility's decision to build a reactor, since the lower uranium costs in fact accrue to the benefit of LWRs, the competing technology. Indeed, to the contrary, the greater are the real social benefits of the breeder, the less are its benefits in the narrow sense — the more successful the breeder program is in reducing uranium costs, the less attractive will it appear to each individual utility, since the apparent fuel cycle advantage, as defined in the narrow sense, is reduced correspondingly.

Based on the best current estimates of our ultimate uranium resources and the growth of nuclear power, the operation of one 1,000-MWe. breeder starting up in 1989 will save the nation \$216 million (present valued to 1975) in uranium costs by 2030, of which only 49 per cent is due to the internal effect that the utility will see directly by purchasing the breeder reactor. If our uranium resources prove to be twice as abundant as the A.E.C. forecasts, a breeder would still save \$113 million in uranium costs, of which only 51 per cent is the internal effect.

The fuel cycle advantage of the breeder over the LWR has been expressed in terms of the capital cost premium which can be paid for a breeder and still permit it to remain competitive with an LWR. This "narrow" margin due to the internal effect is about \$450/KW.e. of capacity, reflecting the rise in the costs both of uranium (averaging \$70/lb U₃O₈) and separative work (\$75/SWU) over the plant's lifetime. This measures the maximum extra capital investment which a utility would be willing to pay for a breeder (in 1975 dollars, but referenced to start-up in 1989). For comparison, in

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Continued on p. 72

Persistent Pesticides and Wildlife

In earlier articles in this series, I have explored the mechanisms by which persistent chlorinated hydrocarbons — PCBs, pesticides, and their breakdown products — have become widely distributed in the environment and concentrated in the tissues of fish, birds, and mammals. My goal has been to assess the hazard posed by these chemicals to sensitive wildlife species.

The subject is a thorny one to approach, involving a conflict between strong and determined forces: the financial and institutional interests of the agro-chemical industry, and the interests of sportsmen and conservationists in maintaining commercially and aesthetically valuable wildlife. There have also been serious scientific disputes between specialists in ecology and in pest control, who have generally been trained in different traditions and often have little respect for one another's methods or assumptions.

To avoid some of these controversies, this article will focus primarily upon examples in which the scientific evidence for damage to wildlife is particularly clear, involving chemicals or uses which have been phased out and are no longer in serious contention.

And it should be further emphasized that I am concerned here exclusively with the persistent chlorinated hydrocarbons.

Use of persistent chlorinated hydrocarbons often has subtle and far-reaching effects. In the 1950s, Dutch elm disease was controlled with DDT. When the pesticide was washed off the trees by rainfall into the soil, earthworms took it up — and thousands of robins, which depend on earthworms for food, died as a result.

The insecticides in this group — DDT, aldrin, heptachlor, etc. — all have a broad spectrum of action: they kill not only target pests, but a wide variety of other insects and related arthropods as well, including many important as food for other animals. In addition, many are highly toxic to vertebrate animals.

Viewed as management tools, most pesticides are crude and unselective; the long-lived pesticides are particularly so, since they cannot be used with precise timing. Thus we need not debate whether or not these chemicals affect wildlife: it is axiomatic that they do, for that is their purpose and function. The question to be addressed is whether their special properties — persistence, mobility, storage in organisms, and ecological magnification — make them *more* damaging than non-persistent alternative chemicals. The question is important because persistence is precisely what makes them convenient and cheap.

Birds, Beetles, and DDT

There is in fact abundant evidence that the properties of persistence and biomagnification have led to special problems of wildlife damage. One of the classical pesticide-wildlife problems involved the control of Dutch elm disease in the 1950s. This disease, responsible for widespread destruction of American elms, is

caused by a fungus carried from tree to tree by bark beetles. For years the preferred method for retarding the spread of the disease was to spray the trees with DDT, which formed a residual coating lethal to beetles for many months. Unfortunately much of the DDT was washed off the trees by rainfall into the soil, where it was taken up by earthworms to levels which proved deadly to the robins which ate them. Even when DDT was applied in late autumn after the leaves had fallen and the robins had left, it nevertheless proved lethal to the robins upon their return in spring. Robin mortality ceased abruptly when DDT was replaced by methoxychlor, a chemical analog which is similarly persistent and has a long residual activity against the beetles, but which is fairly easily broken down by animals and is not accumulated to lethal levels. Thus the key to the drastic effect of DDT was not simply its persistence, but its resistance to metabolism and consequent ecological magnification.

Similarly delayed effects have been reported in other studies. When DDT was used to combat forest insect pests, mortality of ground-feeding birds and mammals often did not ensue until several weeks after application. When heptachlor was used widely against the imported fire ant in the Southern states in the 1950s, some of the most drastic effects were on populations of wintering birds, even in areas treated in spring or summer.

In Great Britain, the introduction in 1956 of aldrin, dieldrin, and heptachlor as dressings to protect wheat seeds from insect attack after planting led immediately to large-scale mortality of birds and mammals that fed on the treated seeds. Although the most spectacular kills were of pigeons, pheasants, and seed-eating mammals, the most long-lasting population effects were on predatory birds and mammals — hawks, owls, foxes, and badgers — which fed selectively on poisoned prey. In an initial attempt to limit wildlife damage, use of the chemicals was restricted to seed sown in autumn when other food was abundant. However, studies showed that the chemicals were nevertheless accumulated over a period of





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weeks by insects and rodents so that poisoning of hawks, owls, and badgers continued during the winter months. Ultimately the persistent seed-dressings were banned altogether and replaced by more easily metabolized insecticides. Although kills of seed-eating birds are still reported intermittently, the hazard of secondary poisoning to their predators now seems to have been eliminated.

Yet another example is provided by the insecticide Telodrin, manufactured in the Netherlands for a period in the 1960s, but since withdrawn because of its high toxicity. Effluents from the manufacturing plant led to widespread contamination of fish and shellfish in Dutch coastal waters, and thus to spectacular mortality of fish-eating and mollusk-eating birds. In the eider duck, most deaths were of nesting females, since they fast for several weeks while sitting on eggs, gradually consuming body-fat in which the chemical was preferentially stored. After the effluent was controlled in 1965, levels of Telodrin in the mollusks gradually declined, but mortality of nesting eiders continued for several years: some were shown to have succumbed to a combination of a sub-lethal dose of the chemical and a sub-lethal load of parasites. As in the cases considered earlier, the chemical's persistence as it was passed up the food-chain was the critical element in its toxicity, but in this case its effects were modulated by other ecological factors peculiar to the species it affected most severely.

A Subtle Insinuation

Most of the examples mentioned have involved birds — not so much because birds are especially sensitive to these chemicals, as because their deaths are often easy to detect and they are relatively easy to study in the field. Although the documentation is less voluminous, there is evidence that other classes of animals have been affected at least as much as birds. Bats, for example, are peculiarly susceptible to DDT, and their populations have been dramatically reduced in some areas where DDT has been widely used. In a recent study in Britain, bats sampled at random carried residues of DDT only slightly

below lethal levels. Although DDT use in Britain has been comparatively light, it has apparently been sufficient to contaminate the bats' insect prey to hazardous levels. There are also reports of bats poisoned by lindane and other chemicals used for preserving wood in the buildings where they roost.

Fish-eating mammals are subject to special risk because of the widespread contamination of fish. Seals in the Netherlands and sea lions in southern California have recently been found to reproduce abnormally and unsuccessfully: the effects are associated with high residues of both DDE and PCBs in their tissues. Breeding failures were also induced in captive mink when they were fed wild salmon caught in New Brunswick and in Lake Michigan: the fish carried residues of PCBs.

Fish are very susceptible to persistent pesticides. Two classic cases of damage dating from the early 1960s are the reduction in the salmon runs in New Brunswick rivers following the spruce budworm control programs, and the fish kills in the lower Mississippi River, traced to effluents of endrin from a manufacturing plant hundreds of miles upstream. Nowadays sublethal effects, such as effects on reproduction, are of primary concern in wild fish populations and are known to be caused by several of the chemicals. Especially disturbing is a recent report of substantial biochemical changes in experimental fish exposed to dieldrin, at concentrations only a little higher than those in the Great Lakes, and lower than those in many North American rivers and estuaries.

In selecting the above list of examples, my purpose has been to show that the properties of persistence, storage, and bio-magnification can make these chemicals especially hazardous to wildlife, even to animals exposed indirectly. By concentrating on the more spectacular incidents of damage, I have avoided what is perhaps the most important question: to what extent has the wide dispersion of these chemicals caused general ecological effects in untreated areas?

Continued on p. 69

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Can We Achieve a Truly Tolerable Planet?

Special Report
by
Stuart Chase



We reached the moon and came back safe and sound in the grandest technological feat in history. But can we organize a tolerable planet in the age of high technology? "What is the use of a house," Thoreau once asked, "if you haven't a tolerable planet to put it on?"

Here are some notes which try to explore this question. It is hard to think of a more important one.

Almost 4 billion human beings, no less than a quarter of all the people who have ever lived on earth, are now alive. If present rates of growth continue, there will be 8 billion of us by the end of the century. Already serious famines are reported in Africa and Asia. Walter Sullivan, Science Editor for the *New York Times*, quotes an estimate: "Unless births in South Asia are brought down to the death-rate level, half a billion children will die between 1980 and 2025."

The arms race shows no sign of abating as the S.A.L.T. talks stumble and the détente with Russia sets megaton limits which are higher than the present ones. A rousing new generation of thermonuclear monsters is on the drawing board or in production. "If we have not reached an agreement well before 1977," said Henry Kissinger in Moscow recently, quoted by Senator William Fulbright, "then I believe you will see an explosion of technology . . . at the end of which it will be impossible to describe what strategic superiority means. And one of the questions which we have to ask ourselves as a country is, What, in the name of God, is strategic superiority?"

The air, water, and land of the planet continue to take a beating in 1975, with a number of attempted controls, such as those on automobile exhausts, discontinued or modified. The United States prepares to tear apart its Western lands for open-pit mining.

The rift between the high-energy world, one-third of mankind, and the low-energy world, two-thirds of mankind, is growing wider. It is exacerbated by the 400 percent price increase through which the Arabian states exploit their monopoly on world petroleum. Already the high price of oil is seriously disrupting world trade and world finance, to say nothing of undermining the so-called "green revolution," due to the cut-back in fertilizers derived from petroleum. Now this ploy is being extended to other essential raw materials, such as the bauxite of Jamaica, which furnishes most of U.S. aluminum.

Perhaps the most pertinent generalization that can be made about the human condition today is that technology, especially in the form of inanimate energy, has fashioned a new type of civilization altogether. It embraces the whole planet. Lord Ritchie-Calder and other keen observers are calling it the *last* civilization — something totally beyond Greece or Rome or the Incas. It begins to appear that all nations — all 149 of them — must actively

and peacefully participate in this world-wide structure based on technology if their citizens are going to eat. But political leaders seem grimly determined not to relinquish any part of their national sovereignty.

Look at the row over the potential riches of the ocean at the Caracas conference in 1974. They should be a treasure trove for all mankind. A long list can be made of world-wide issues to which no purely national solutions are possible: nuclear arms, energy, pollution, monetary exchange, food supply, are but a few.

Albert Szent-Gyorgyi, Nobel laureate biochemist, estimates that in the age of the atom, modern communication and transportation have shrunk the globe 100-fold, while the force of weapons has increased a million-fold. What throne, what oval office, can maintain sovereign independence against such a combination?

Most biologists agree that there has been little change in human genes since Stone Age times, 50,000 years ago. Changes for better or worse have been mostly cultural. Thus the logical task before us is to bend the culture toward the supervision and protection of the last civilization. Can we jointly find a way to meet the problems which no sovereign state can face alone?

Some Assets

The prospect is not altogether dark. The very fact of the technological imperative — as manifested in, say, the energy crisis — puts constant pressure on political leaders, communist and capitalist alike, to act their age. The expanding movement to save the environment, with millions of young people involved, is world-wide, quite unprecedented, and aimed directly at a more tolerable planet. Theodore Roosevelt would be as pleased as he would be astonished at its massive impact. It just might be the beginning of a new ethical system — a kind of revival of the earth-mother idea. I suspect Thoreau would approve it.

More verifiable knowledge, in both the physical and social sciences, is now available than ever before. For one thing, the findings warn against unlimited growth in population and heavy industry. The Club of Rome has been a stimulating force in exploring exponential growth curves and arousing world-wide discussion and controversy. Most environmentalists march with the Club; most economists are skeptical.

Yes, a number of encouraging assets can be found, along with the somber liabilities of 1975. Now we turn to the prospects for:

A Steady-State Society

Though such a society will not be quite Utopia, *homo sapiens*, if he can make it, may be able to keep going with some peace of mind — at least until the next Ice Age. It can hopefully give our

children something to believe in again, and to live for.

In 1857, more than 100 years ago, John Stuart Mill saw the need for steady-state conditions. He said: "It is scarcely necessary to remark that a stationary condition of capital and population implies no stationary state of human improvement. There would be as much scope as ever for all kinds of mental culture, and moral and social progress; as much room for improving the Art of Living, and much more likelihood of its being improved."

If it was scarcely necessary to remark so in 1857, it is definitely necessary today. The Art of Living, of course, is another name for our modern phrase, the Quality of Life.

The elements of the steady-state condition need far more exploration; but it is not too early, I think, to list a number of logical requirements.

— There must be a global society. Technology has fashioned the last civilization, as already noted, and the steady-state society must be world-wide, with nations no longer uniquely sovereign but limited to local concerns. It must be prepared to halt any wars or preparation for wars, or any nuclear terrorism, anywhere on earth.

— This global society must be responsible for the biosphere of the planet, helping to keep all living things healthy and as pollution free as scientific knowledge permits; this would include the maintenance of a population growth rate of not more than zero against the present two per cent. A negative rate may be necessary in some areas.

— The society must hold the material resources of the planet at par — shortages compensated by overages. John Stuart Mill demanded a condition of heavy industry such that new capital investments were balanced against depreciation.

— As a society it must favor the non-wasting energy sources of sun, wind, tide, and hydro-electric installations in contrast to wasting assets of oil, gas, uranium, and coal. (Is geothermal both?)

— The society must seek to provide an adequate living for every child — food, shelter, health service, education, recreation. It can probably guarantee electric power to every household, but hardly air conditioning, or a fuel cell car.

— The society must be built on a worldwide system of money and credit. Not one person in 10,000 understands how money works today. In the steady-state society children should know how it works before they are ten years old. They should also know a simple world language in addition to their native tongue.

— The society will — following Mill — give massive encouragement to the arts and sciences. It will also include a competent effort in technological assessment to pass on new inventions — shall they go into mass production? (We now have a prototype on a small scale in Washington.)

The reader will doubtless raise plenty of qualifications, while some cardinal imperatives probably have been omitted. The preceding points, however, give at least a rough idea of what a steady-state society might look like. For some of us in the affluent society of today, it may look very rough indeed; but for most members of the race, one suspects, it would look pretty tolerable.

Transition — Three Roads to the Future

So much for a preliminary scenario. How do we move from here to there? Granting that high technology has forged a single, and probably the last, civilization, how can *homo sapiens* in due course come to enjoy it? Short of a providential miracle, it is possible to imagine three ways to make the passage from say 1975 to 2050, a matter of three human generations:

First, by logical argument. Extremely improbable, but if the semantics is sensibly planned, it could help the transition.

Second, by limited catastrophe. A series of great famines, a great plague, a limited nuclear exchange, might drive home the lesson well short of a cosmic disaster. Hiroshima obviously was not enough of a lesson.

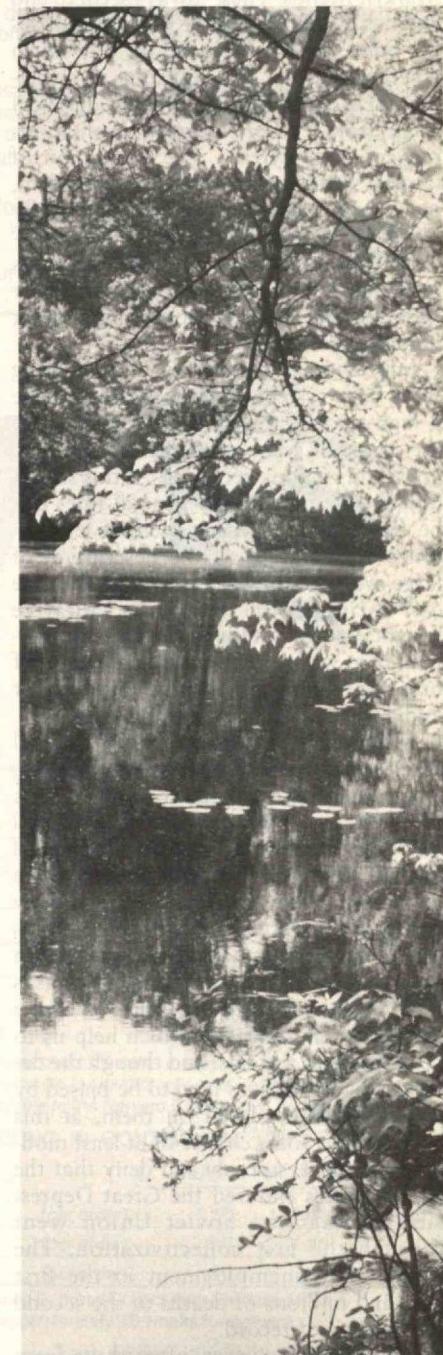
Third, by functionalism, defined as the ad hoc creation of international and supranational agencies to meet acute global problems as they arise or even before they arise — such as the control of energy, of multinational corporations the defusing of the arms race. Some global agencies are already functioning — the Red Cross, the Universal Postal Union, the World Weather Watch, the joint control of satellites, control of Antarctica. . . . One by one the necessary agencies and controls are set up and effectively administered until, without any formal speeches or brass bands, the steady-state society as a functioning system is in place.

Perhaps this achievement will be disciplined to begin with by the greatest powers. Perhaps the Secretariat of the United Nations will undertake initial administration. Many in the U.N. are world men with a global view, as was U Thant, although the Assembly with its ideological nationalists will not be very helpful.

Logic and argument, limited catastrophe, a step-by-step functional approach — if the steady-state society is ultimately achieved, it is highly probable that all three roads will be followed.

The question remains: Can the human organism, with its 46 chromosomes little changed since the Stone Age, remove the devastating cultural lag of the 17th-century sovereign state and so permit a tolerable planet?

Stuart Chase, who is widely known as writer and critic on economics and social affairs, was a special student at M.I.T. with the Class of 1910. He is now working on a book on the subject of this report.



The Evaluation of Large Systems

Fragile
Planet?

I have been having some rather lively discussions lately with some of my neo-Marxist friends. These always seem to end inconclusively — neither of us persuades the other and we both end up very much where we began. Our difficulty in resolving these intellectual conflicts arises, I think, from a difference in our evaluations of very large systems. The evaluation of large systems itself is a difficult problem, one which cannot easily be resolved by simple discussion or argument. Nevertheless, these remain questions of enormous importance, pregnant with potential for vast human misery, or perhaps great human satisfactions.

Improving our methods of evaluating these large systems, therefore, seems to be a high priority for the human race if we are to avoid what might be catastrophic error and ruinous decisions. At this stage I doubt very much if any general rules can be formulated to assist in these evaluations. Nevertheless, if the description of large systems can be improved, and if we can estimate the relative evaluative weights given different parts of the system, then we have at least some chance of breaking down the problem into smaller and perhaps more manageable pieces.

The continuing debate in the general area of socialism versus capitalism, centrally-planned economies versus market-type economies (which could well be titled "the Marxist debate" because of Marx's enormous influence on it) is a good case in point. If that debate simply compared existing systems it perhaps would be more manageable, even though the mere description of existing systems is difficult enough. We do, however, have certain social indicators which help us to describe these systems, and though the descriptions themselves tend to be biased by the evaluations placed on them, at this level there is some chance of at least modest agreement: nobody can deny that the United States endured the Great Depression or that the Soviet Union went through the first collectivization. The 25-per-cent unemployment in the first case and millions of deaths in the second are matters of record.

The debate, however, often shifts from

comparison of existing systems to comparison of ideal or potential systems, and here, of course, it is more tenuous. It is easier to study what is than what isn't, even though what isn't may be much more interesting or even more important. The debate becomes especially fruitless when it involves a comparison of an ideal system with a real one, such as ideal socialism with real capitalism. However, we cannot wholly discount the comparison of ideal systems insofar as these are regarded as potential in the future. So the comparison has to involve something like probabilistic dynamics as well as the simple state description of systems as they exist in a moment of time. The description of a state is difficult enough: the description of potential or future states compounds this difficulty by an order of magnitude. Yet such complexities cannot be brushed aside; they must be faced, for they are part of what the argument is about.

Establishing the Arena of Debate

One of the great difficulties is that of establishing agreement on what are the more probable syndromes of these large systems. On the one hand we see absurd dichotomies. Any argument which assumes that there is one thing called "capitalism" and another called "socialism" is patently ridiculous. There are many different kinds of capitalism and many different kinds of socialism and a good many systems which lie somewhere between. Dichotomous evaluations, therefore, are doomed to failure simply because they attempt to evaluate something which really doesn't exist. Any social system may be identified by a point in n-dimensional space, where each dimension represents one of its significant characteristics or variables. In this n-dimensional space, however, the systems do not form a simple continuum. There are at least clusters and syndromes that are more likely to be related than others. These are particularly important when one discusses potential. If there are real limitations on what characteristics and variables can go together, then there is no use postulating as potential some syndrome which is internally in-

Technology/Society
by
Kenneth E. Boulding

compatible or unlikely to exist.

Frequently the resolution of these arguments is made more difficult because each party to the argument is really operating in a different n-dimensional space. Each neglects certain characteristics of systems, perhaps because the consideration of these characteristics might threaten an existing position. In conflict theory this is the problem of agendas: if the two parties to a conflict assume different agendas — that is, if they are operating in different social spaces — resolution of the conflict will be extremely difficult. One of the values of argument and discussion, indeed, is precisely the widening of agendas, which forces people to consider variables of the system which they might otherwise have neglected. Part of the problem here goes back to the sheer difficulty of state descriptions of large, complex systems — and this is an area where intellectual analysis should be helpful. Even here, however, a problem arises when easily quantifiable variables or conditions tend to dominate people's images of systems, so that conditions or variables which are not easily quantifiable are ignored. It is fairly easy to quantify the concept of the distribution of wealth or of income; it is extremely difficult to quantify the concept of the distribution of power, although that is perhaps even more fundamental. Consequently, the socialist criticism that capitalism involves too great inequality in the distribution of income, and the capitalist criticism that socialism involves too great inequality in the distribution of power, simply never intersect because of the incompatibilities of concept and measurement.

The Real Terms of the Argument

As one looks at the history of 100 years of Marxist debate, one is struck with the fact that on both sides there are very large omissions with regard to what the debate is all about, simply as a result of the sheer difficulty of conceptualizing large systems with so many dimensions. The socialist attack on private property and profits and the capitalist economists' defense of them has largely revolved around the question *Continued on p. 69*

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Marketing: Science at Home Here, too

Handbook of Marketing Research
Edited by Robert Ferber
New York: McGraw Hill Book Co.,
1974, 1440 pp.

*Marketing Research: Analysis and
Measurement*
Peter M. Chisnall
London: McGraw Hill Book Co., 1973,
308 pp.

Reviewed by Gary L. Lilien

N.A.S.A. would never consider launching a lunar probe without a most careful modelling and analysis of the effect of rocket thrusts and celestial forces on the probe's path. On the other hand, many "launches" in a marketing sense (new products, new sales campaigns, etc.) take place with little more than a strong "gut-feel" about probable outcomes. Are marketers basically qualitative types, or are marketing problems really more difficult?

Consider the factors involved in the purchase of a brand of toothpaste. A purchaser's decision involves balancing personal perceptions about each available brand's whitening power, decay-prevention ability, breath-sweetening quality, price, and taste, etc. together with the importance he attaches to each attribute. Mr. Jones and Mr. Smith may both perceive MacCleans as more "whitening" than Crest but Crest as more "decay-preventing" than MacCleans. Yet Jones may buy Crest and Smith may buy MacCleans because of the different importance they attach to these characteristics.

Life is still more complicated: How does an individual become aware of a brand and its characteristics? It may be through marketing communications, which includes advertising (television, radio, news media, billboards, leaflets, etc.) and personal selling (a door-to-door salesman, for example). Or he may receive a sample in the mail. Or at a store. Or an

influential neighbor may recommend the brand. Or he may read a news article about it.

Differences among individuals cause them to react differently to the same marketing strategy. A price increase for a consumer durable good can leave its total sales rate unchanged; a closer analysis may reveal that more "rich" are buying (for status or imputed quality reasons—"it costs more so it must be better") while fewer "poor" are buying it than expected.

There are, then, several reasons technical methods are not as highly utilized in marketing as in the physical sciences:

— *Complexity of the phenomena:* Many factors can influence market behavior, often in non-linear ways. They interact with one another: The effect of a price-off and an ad campaign may be either more or less than the sum of the individual effects. They lag and carry-over: This month's ad may not affect sales until next month and may continue to have some effect for six months.

— *Problems of measurement:* What is one's "attitude" toward a brand? How does an ad or price change affect that attitude? How does that attitude relate to the likelihood of purchase? People who say they prefer Colgate to Crest sometimes buy Crest. Why? How do we measure the effect of our new ad campaign when competitor A lowers price, B goes bankrupt and leaves the market, C introduces a new product, and the government institutes new price controls at the time of the ad?

— *Changes in the environment:* The world just doesn't seem to stand still long enough to understand it. We were studying the effect of games and credit card mailouts on gasoline sales several years ago and we thought we just about understood the phenomena when both types of promotions were made illegal.

Though marketing research may never be expected to demonstrate the quantification and predictive accuracy of the physical sciences, important progress has been made in the past several years. Much statistical methodology used in the biological and psychological sciences has been adopted. The behavioral sciences have

provided a series of theories and techniques, and operations research and management sciences have provided tools and methods to aid in decision-making. But if we can't go "all the way," where is the value? Frequently we can develop enough of an understanding of the crux of a problem to at least improve a decision.

We were studying the effect of promotions (beer-mug giveaways, etc.) on retail gasoline sales for a "major" U.S. brand. The company (which we will call Petrogas) was then offering such a promotion semi-annually in each of its market areas. Petro's implicit philosophy was that it would be able to draw customers from other brands and that once they tried Petro, they would be retained as loyal customers. A detailed market research study showed that most of Petro's volume came from "class-loyal" buyers — buyers who purchased either Petro or one of several other major brands. These "class-loyal" buyers ordinarily bought, say, 20 per cent of their volume from Petro; during a "deal" period they may buy 60 per cent. But virtually no new triers were found to buy during a promotion. After the promotion, the class-loyals dropped back to their customary level — 20 per cent of their purchases for Petro — and no new long-term volume had been acquired. This observation about the dynamics of the purchase process suggested a steadier, longer-term promotion instead of a semi-annual promotion; this might switch the class-loyals over on a more permanent basis. It was tried and was successful.

Ferber's book is the most comprehensive treatment of the tools and uses of market research currently available. The layman or market research generalist will find information about all phases of market research philosophy and techniques. The practitioner will find it as complete a treatment of the field as is now available in a single volume. Though the work of 89 contributors, the book is remarkably even and readable. An added advantage for the less knowledgeable reader is that many chapters present material at two levels: a self-contained non-technical overview first, followed by a more technical treatment later.

But while Ferber's book in this field is unique and distinguished, Chisnall's is common and trite. It is one of a number of such books which purport to present marketing research material for beginning students and general audiences. It lacks the style and clarity of purpose to do a worthwhile job and, instead, is but another summary of the techniques of the field.

More of our research money is being spent on "human needs" now than ever before. As this material filters down, marketing research will gain advantage. Scientific research findings are neither good nor bad in themselves; rather there are good and bad uses of science. Marketing research is no exception. The people who brought (and sold) you colored sugar disguised as cereal can also bring you (and sell you) better methods of population control. And let's hope they do.

Gary R. Lilien is Assistant Professor of Management Science in the Sloan School of Management at M.I.T.

Pistons and Paintings: An Uneasy Marriage

Zen and the Art of Motorcycle Maintenance: An Inquiry into Values

Robert M. Pirsig
New York: William Morrow & Co., Inc.,
1974, 412 pp., \$7.95

Reviewed by Deborah McGill

The estrangement between technology and art has been well-documented and is by now a truism. One thinks of C. P. Snow's *Two Cultures* but need look no further than the local newsstand. Its history can be traced from the optimism which first greeted the Industrial Revolution in the 19th century to the flowering of antipathy during the political, social, and environmental movements of the 1960s.

The shapes and colors technology assumes have contributed to this disaffection. The fearsome ugliness of many laboratories, of computer consoles, and all the packaged, plastic commodities fresh from the factory sends the uninitiated scurrying back to the more familiar, more easily seen beauties of art. From this secure vantage, one's bewilderment can be masked with scorn or a cool superiority.

But deeper than aesthetic distaste lies a more complicated issue. Technology appears so utterly rational and pragmatic, allowing no play of emotion or creative imagination. Goods roll off the assembly-line stillborn and smelling of the grave. No wonder, then, the current revival of crafts: a flawed product of the basement

workbench seems more valuable than any perfect item made by machines.

These, at any rate, are the attitudes I have encountered and, to a great extent, shared. Coming to M.I.T. after four years at a liberal arts college and a fifth as a graduate student in English, I expected at best an amusing experience. Certainly I could not hope to feel at home in my surroundings: Would I even speak the same language? Yet the disdain I had so carefully cultivated was punctured again and again. The students were not only bright — that didn't surprise me — but articulate. Movies and plays abounded, a creative writing center thrived — all testifying to minds equally at home with the arts as with computer programs and test tubes.

So the burden shifted, as I began to realize the limits of my own education. There had to be something in science and technology that I had missed, or that some false assumption had obscured.

As I explored, the break between technology and art ultimately became most visible along a traditional fault line: reason versus emotion, objectivity versus subjectivity. The machine and the painting are merely concrete metaphors for an old problem, a problem Robert Pirsig, in this most ambitious work, attempts to resolve.

The Buddha in the Machine

When *Zen and the Art of Motorcycle Maintenance* first appeared last year, it was enthusiastically reviewed in most of the literary magazines, and all but ignored by the scientific and technical journals. Yet the book speaks as well to the technologist as it does to the humanist, for its task is to reconcile them.

The book is the account of a journey Pirsig, a 40-year-old technical editor, and his son Chris take by motorcycle to California. Spliced to details of the scenery — backwater towns, countless diners, the expanse of prairie and mountains — are lectures Pirsig calls "Chautauquas": "an old-time series of popular talks intended to edify and entertain, improve the mind and bring culture and enlightenment to the ears and thoughts of the hearers." The series begins with a seemingly trivial question: Why are Pirsig's friends John and Sylvia so irritated by the details of motorcycle upkeep? The author reasons that their irritation is part of a larger hostility towards technology itself that turns upon a mistaking of surface appearance for underlying form. His friends see, as do many of us, only the "high barbed-wire fences, locked gates . . . ugly strange shapes of metal and brick whose purpose is unknown." And so the rational intelligence at the heart of technology loses its dignity, its beauty — its divinity. Yet, according to Pirsig, the source of technology is also the source of art; the same ordering, imaginative capacities are called forth, only in different modes and working within different

constraints. "The Buddha, the Godhead, resides quite as comfortably in the circuits of a digital computer or the gears of a cycle transmission as he does at the top of a mountain or in the petals of a flower. To think otherwise is to demean the Buddha — which is to demean oneself." Here is language, one would think, to make the technologist squirm — at least the white-coated technologist of popular myth. Yet its very strangeness is restorative: to speak poetically about technology is to make a home, through the sheer force of words, for technology in art.

Caring About Quality

It is no accident, then, that the book is subtitled, "An Inquiry into Values." Pirsig argues that technology has no inherent moral or aesthetic quality. One cannot condemn an article simply because it is made of plastic. Instead, the quality of an object derives only from its interaction with the maker. Once you understand the interior logic of a machine, you learn to care whether that logic is expressed as perfectly as it can be. And so what Pirsig is advocating, at bottom, is a return to the ethic of craftsmanship, which is a form of caring, of love. If the machinist or the repairman or the keypuncher cares about his work enough, and his work environment allows expression of that concern to the fullest, his produce must inevitably have good quality — the same quality one

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observes in, say, a successful piece of sculpture.

A simple formula, but how compatible with our present automated systems?

The idea, at least, is catching fire as a growing number of corporations recognize the importance of re-establishing the workers' sense of connection with the final product — to mutual benefit. Assembly-lines are being split up into small work groups or project areas, with broader areas of responsibility assigned to each worker. And reports suggest, not surprisingly, that employees are happier with this system. At an experimental Volvo plant in Sweden, absenteeism has declined and the quality of work has improved.

So poor quality is not the result of technology *per se* but rather of a failure in attitude. Inhumane architecture, poor design and shoddiness of material are symptomatic of skewed values — not caring whether a product is made well because one has no personal investment in it, no connection with it. The same failure extends to other areas of our lives. Pirsig ruminates about the absence of kindness in our dealings with one another, connecting the word to an older one: "kin." Modern society has become so fragmented that we have lost the sense of kinship, of inter-connectedness. It is that sense which once allowed art and technology to reside together comfortably (Pirsig points out that in Greek a single word, *technos*, encompassed them both). And it is that sense, finally, which must bring them together again. If we care about one another, there is no room for easy prejudice. This book goes a long way toward bridging the gaps not only between disciplines but between people, and that is a great service.

Deborah McGill holds an M.A. in English literature from Yale University and is secretary to the editors of Technology Review.

From Refrigerators to Raytheons

The Creative Ordeal

Otto J. Scott

New York: Atheneum Press, 1974, xiv + 429 pp., \$12.95

Reviewed by F. G. Fassett, Jr.

At first thought the title of this volume, which is "published in commemoration of the 50th anniversary of Raytheon Co.," may seem somewhat portentous for an account of the inception and development of an industrial corporation. Not so, however, for the book, far from the usual easygoing anniversary narrative, deals downrightly with one of the most complex, cruel, and confusing half-centuries of modern history.

"The Proper Study of Mankind"

Whether that greater ordeal was creative or not we still wait to learn. That the time was one of creation for the company is clear; as Mr. Scott puts it: "... Raytheon was one of the great seedbeds of the electronics industry. It emerged as a national force during World War II and has remained a great national resource ever since. . . . It is not enormous, but it is big even by American industrial standards. It employs over 50,000 people. Its sales in 1973 amounted to . . . nearly \$1.6 billion. Its earnings after taxes were \$46 million . . . How do private citizens manage to engage in so many activities, collect so many dreams and skills under one roof?"

His answer to that question: "In Pope's time, the proper study of mankind might have been man, as he said. In our time, it is what man can do with other men not as managers — but as associates. To understand what this means we . . . have to look at how this firm started and developed.

The look we take at the start and development of the firm is based on thorough research. Mr. Scott has drawn on interviews with key people in both Raytheon and other organizations and with consultants and observers, and he has made extensive use of the firm's yearly reports, corporate records, and minutes of directors' meetings.

The story of the actual beginnings of the American Appliance Co., precursor of Raytheon, has many of the overtones of romantic fiction: In 1920, Vannevar Bush, then Assistant Professor of Electrical Engineering at M.I.T., was a consultant to American Research and Development Corp. (A.M.R.A.D.), an early venture into the new world of radio broadcasting. To Bush came John A. (Al) Spencer, a young mechanic on the laboratory staff, with a small "dished" bimetallic disc which would snap with a change in temperature. Al Spencer, who had grown up in Maine lumber camps, had also tended furnace in a mill, and had watched the closed circular clean-out door of the furnace buckle and pop in and out as the heat waxed and waned. He had made use of his observations; the thermostatic disc resulted. Bush saw possibilities. He turned to his roommate of undergraduate years at Tufts, Laurence K. Marshall, a physicist turned civil engineer with respectable experience in the business world. Results were the founding in 1921 of Spencer Thermostat Co., distinction and security for Al Spencer, a renewed alliance of the former college roommates, and in the next year the founding of American Appliance Co. by Bush, Marshall, and C. G. Smith, whom Bush had engaged at A.M.R.A.D. — then in collapse with the withdrawal of J. P. Morgan's financial support.

Housed at Kendall Square in Cambridge, the new concern set out to manufacture a domestic electric refrigerator of Smith's design. Time passed; though the

pilot model of the machine worked satisfactorily, there were problems of balance when larger units were tried. By 1924 the decision was made to postpone the refrigerator, and to go ahead with development and production of another Smith invention — a radio tube, the gaseous rectifier, which would eliminate need for the B battery of the radio sets then burgeoning across the nation, and let the set operate directly from a wall plug. Demand was large; production speeded; patent infringements occurred, were combated, ceased; in spite of strong competition from the contemporary giants in the field, the new concern was well launched. Improvements in the tube itself were made by Percy Spencer, Al's elder brother. A vigorous inventive mind, he was a student by inclination who had won skill and knowledge by his own efforts, based on what he had learned of radio and allied topics during a stint in the Navy. Fifteen years later, he was to apply his genius to the problem of improving production of the British-originated magnetron on which microwave radar in the war years was vitally dependent. In 1959, Raytheon Company would dedicate its microwave power tube laboratory to him.

Corporate and Social History

From the mid-20s onward, the history becomes so multifaceted and complex as to defy summary. It posed the author an extremely exacting task, which he has handled in a manner nothing short of masterly. Adopting — and adapting — the general method pioneered by Justin McCarthy a century ago and followed by Mark Sullivan and later by Frederick Lewis Allen, Mr. Scott puts Raytheon events in perspective by interposing summary sketches of contemporary developments as they are needed, so that his book becomes not only an account of how things were with the company but also a succinct and instructive survey of the social, economic, and political history of the period.

It is a method not without perils; juxtaposing events of international sweep with events essentially parochial is risky at best. The cosmic differs from the comic by but one letter, and that is a hiss; Mr. Scott has run the risks successfully.

His introductory redefinition of the proper study of mankind suggests that some of the more personal history should be noted. Vannevar Bush resigned from the corporation's board of directors in June, 1938 to head the Carnegie Institution of Washington and later the Office of Scientific Research and Development. Charles Francis Adams, Jr., joined the board in August of that year. Laurence Marshall continued as President of Raytheon until 1948, then served as Chairman of the Board until 1950, with Mr. Adams as President. Edward L. Bowles, whom Bush had advised in graduate school, had become familiar

with A.M.R.A.D. in the early 1920s and served as informal consultant to Raytheon until he too went to Washington as Expert Consultant to Col. Henry L. Stimson, Secretary of War. He returned to Raytheon as consultant after the peace, and his long association with the enterprise places him as dean of the many M.I.T. men who have contributed to its growth over the years. Mr. Adams was succeeded in the presidency by Thomas L. Phillips. Human interest attaches to the fact that when during the vice presidency of Harold Geneen, 1956-59, psychological assessment to discover "the upper one-third of the upper one-tenth" was instituted, the two who declined to participate were Percy Spencer, Maine's inventive genius, and Charles Francis Adams, the Massachusetts patrician.

Miles Pennybacker, another M.I.T. graduate, while working as sales engineer for American Appliance Co. coined the name "raytheon" for C. G. Smith's radio tube. Hardly had it been adopted before word came that an Indiana concern had prior claim to "American Appliance Co." So the Kendall Square concern became the Raytheon Co. In late 1974 the literary editor of *The New Republic* wrote of "the fierce light of the raytheon tube." Thus Miles Pennybacker's word *raytheon*, lower-case, adjective, joins lower-case *kodak*, noun, lower-case *mimeo*graph, noun, adjective, verb, and lower-case

xerox, noun, adjective, verb, as another contribution of American inventiveness to the English vocabulary.

Frederick G. Fassett, Jr., was Editor of Technology Review from 1939 to 1945; earlier he had endeared himself to a generation of M.I.T. students as a teacher of English, and a later generation remembers him as Associate Dean of Students and Dean of Residence. He is now retired to a life of writing and gardening in Damariscotta Mills (Newcastle), Maine.

Conflicting Urban Values

Cities of Vision

Rolf Jensen

New York: John Wiley and Sons, 1974, xviii + 382 pp., \$18.50

Close-Up: How to Read the American City

Grady Clay

New York: Praeger Publishers, 1973, 192 pp., \$10.00

Reviewed by Ralph Warburton

For centuries before the invention of the printing press, a key concern in city design

was to present an image compelling enough to define and direct the life of the community. The city's form, the site, shape, and decoration of its structures, the provision of ancillary sculpture, and so on were substantially ordered by master designers to engage and shape the public mind. There were both religious and secular squares with church bells and clock towers, and history and dogma were often symbolized in paintings, stained glass, and fountains. The city expressed the past, present, and expected future to its citizens: it was essentially the major mass communication device for the transmission of values, and esteemed for that purpose.

Has the contemporary city become too complex and valueless to be so purposefully "read" by the average citizen? Grady Clay, "clutching yesterday's program, swamped by today's expert view, clawing at the newest opinion polls," thinks a punchy guidebook such as *Close-Up* is necessary: "Experts may help assemble data, specialists may organize it, professionals may offer theories to explain it. But none of these can substitute for each person's own leap into the dark. . . . Whole industries of propagandists, many armed with official powers, push and shove to intrude their views ahead of our

Continued on p. 69

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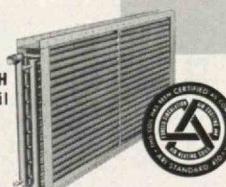
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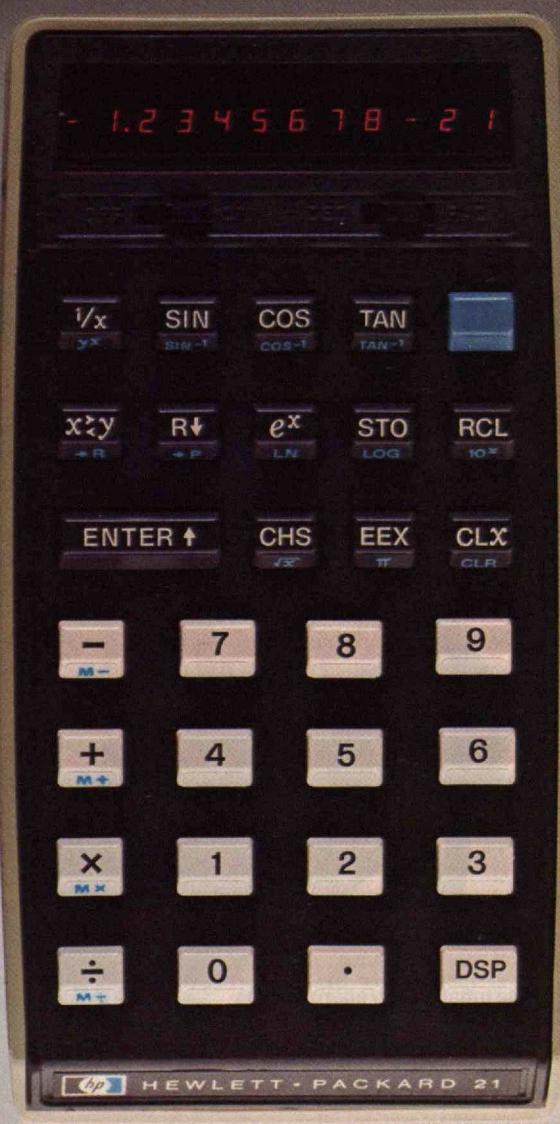
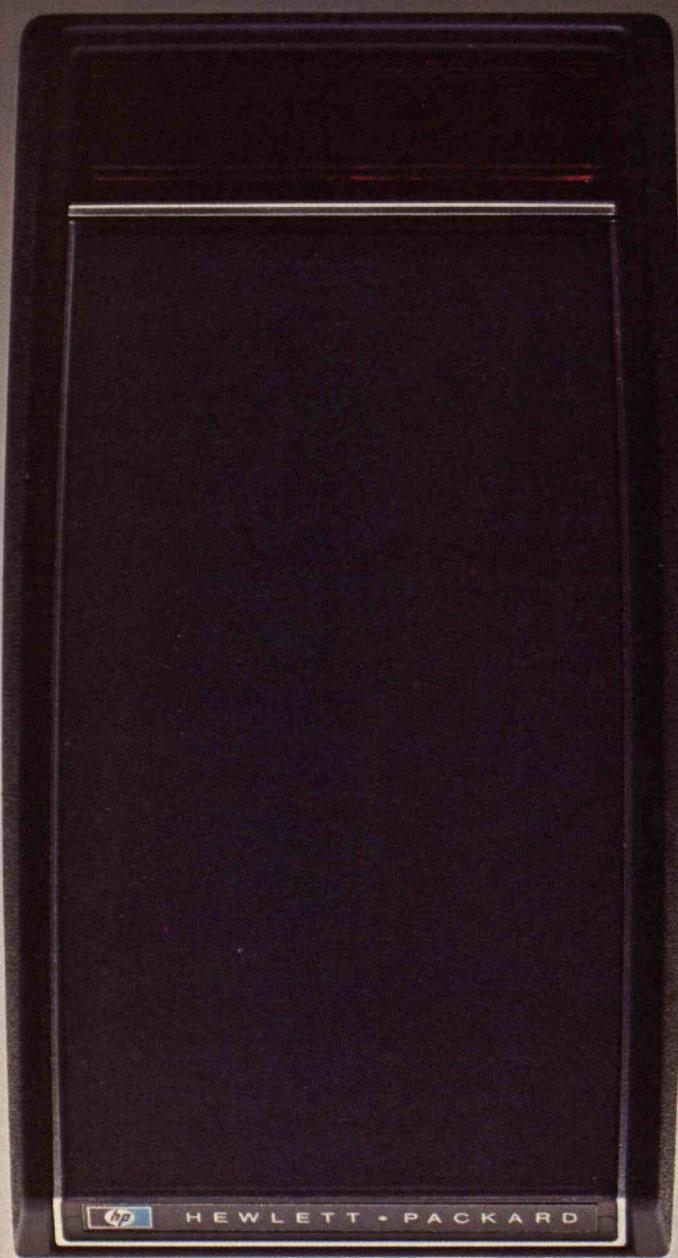
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- The heavy gauge plastic case is designed to withstand a long tumble to a hard floor. Incredibly, one H-P pocket calculator once withstood a trip through a snow-blowing machine. The case cracked, but the machine worked.

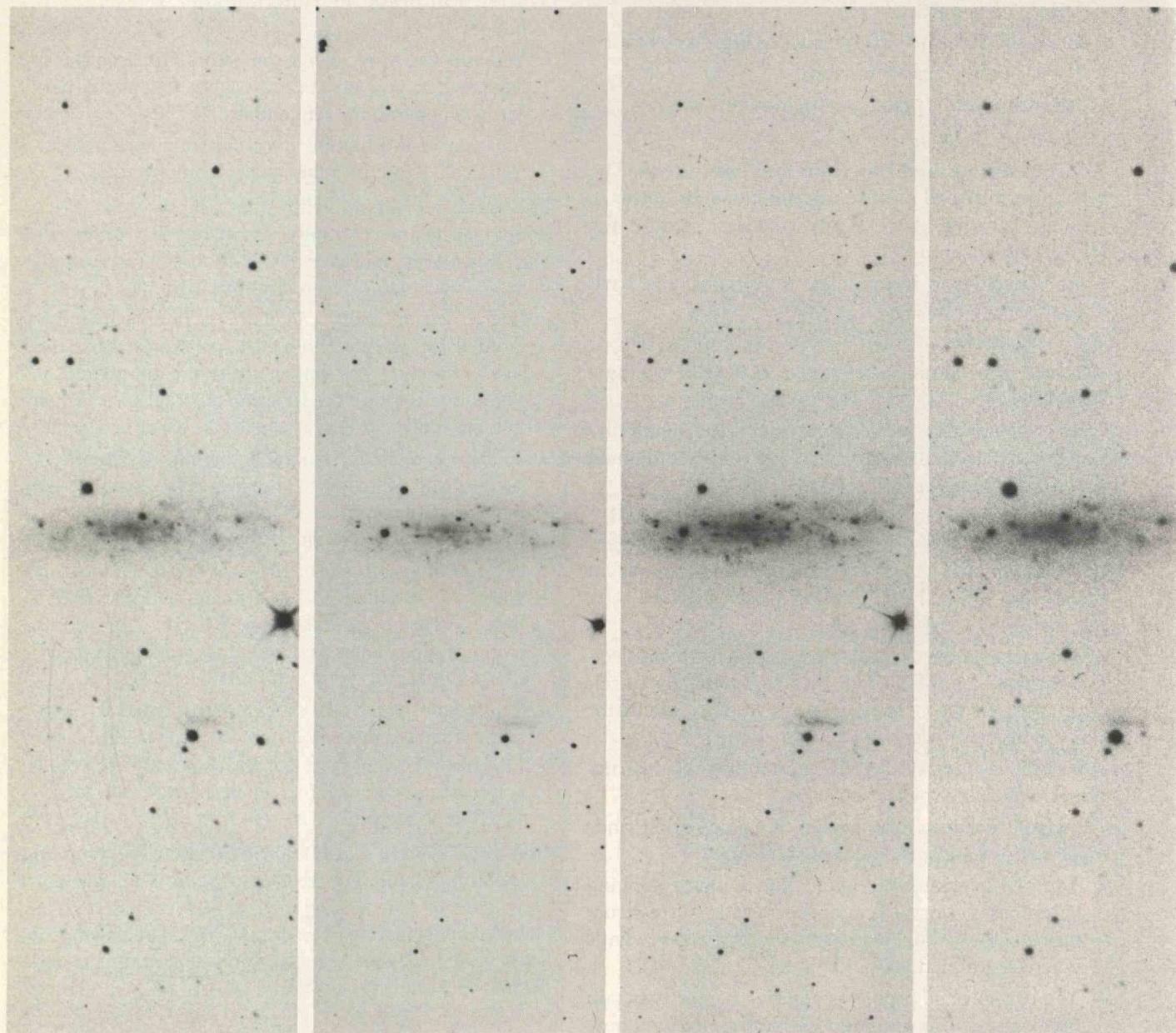
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We cannot yet explain the explosion of a star. But we can try to account for the light we see on earth.



The supernova in galaxy N.G.C. 1003, which reached its maximum luminosity in September of 1937. The galaxy itself is a modest spiral, seen edgewise from earth. In a paper published in the *Astrophysical Journal* in 1938, Walter Baade and Fritz Zwicky calculated that it was 4.9 million light-years away and only 6,500 light-years in diameter. The leftmost photograph of N.G.C. 1003 was taken on November 29, 1926 through the sixty-inch telescope

on Mt. Wilson. The date on which the second photograph was taken is unknown, but comparing it with the first shows that a bright object has appeared toward the galaxy's left edge. The third exposure was made on September 11-12, 1937 through the hundred-inch telescope; the fourth on December 4, 1937 through the hundred-inch telescope; and the fifth on July 30, 1938 through the sixty-inch telescope. The images of the galaxy are

The Light of the Supernovae

Philip Morrison
Institute Professor
M.I.T.

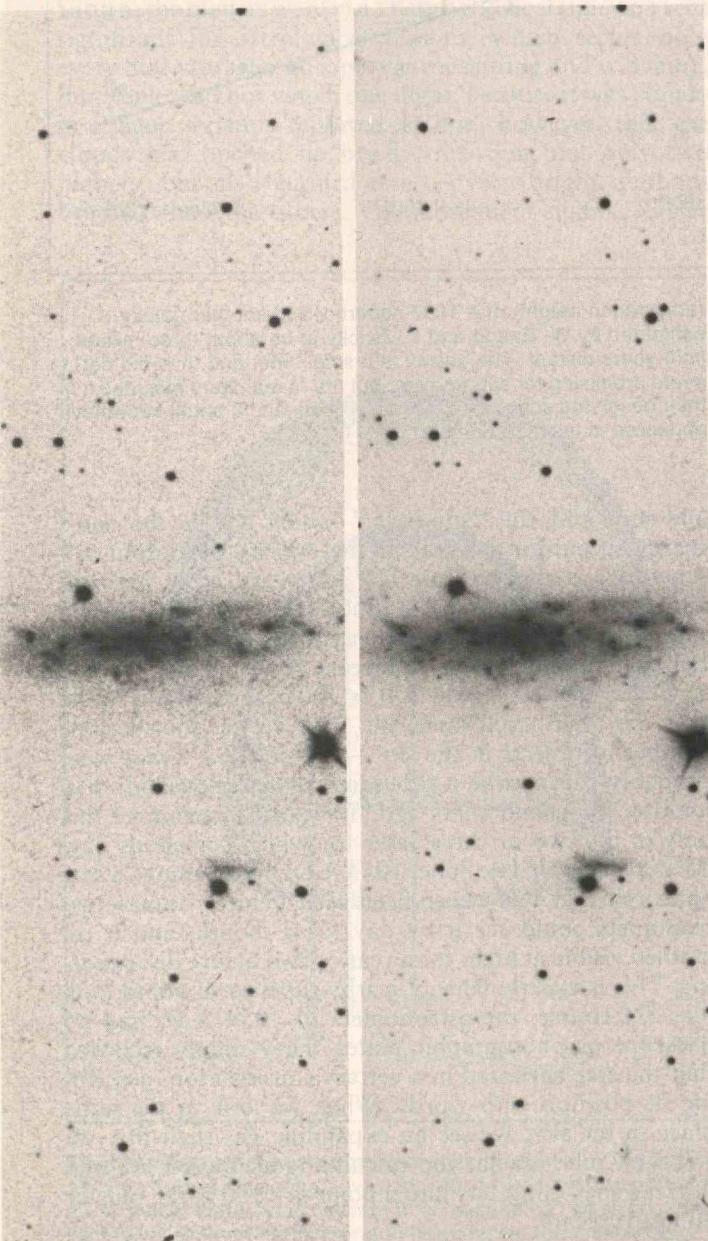
The event called a supernova has acquired a great deal of attention, mostly because of its popularity with science-fiction writers. Still, the explosion of a star is surely a most interesting and important event. The energy released has great influence on the galaxy in which it happens: supernovae are mainly responsible, we now think, for heating the gases in interstellar space and for cosmic rays. More important, the explosions probably create many of the chemical elements. Indeed, plausible arguments suggest that all the deuterium and all the elements much heavier than iron that we find on earth may be here only because they were made in supernovae. Radioactive materials, for example, decay very quickly, so slow processes are precluded for their manufacture. Something had to make them fast if they are to be found on our planet, and the fastest energetic event we see in the sky on a stellar scale is the supernova.

Arguments of this sort suggest that supernovae made our lead, uranium, deuterium, and gold — these being four elements of great importance for human life. Thus, between bullets and printers' type, gold and nuclear weapons, all our troubles seem to come from supernovae, and without them, we might be a more innocent group. But we do not understand what causes these explosions. Scores of learned papers claim to explain them, but they disagree with one another, so we can conclude that at least some of the papers are wrong, and probably all of them are. After all, the world is very complicated and subtle, and trying to guess, as theoretical physicists do, what occurs in supernovae is simply more than our guessing abilities can probably do for us. While calculations exist which work fairly well for normal stars, extrapolating far beyond their proven utility in order to see what happens in these unusual stars is not very promising.

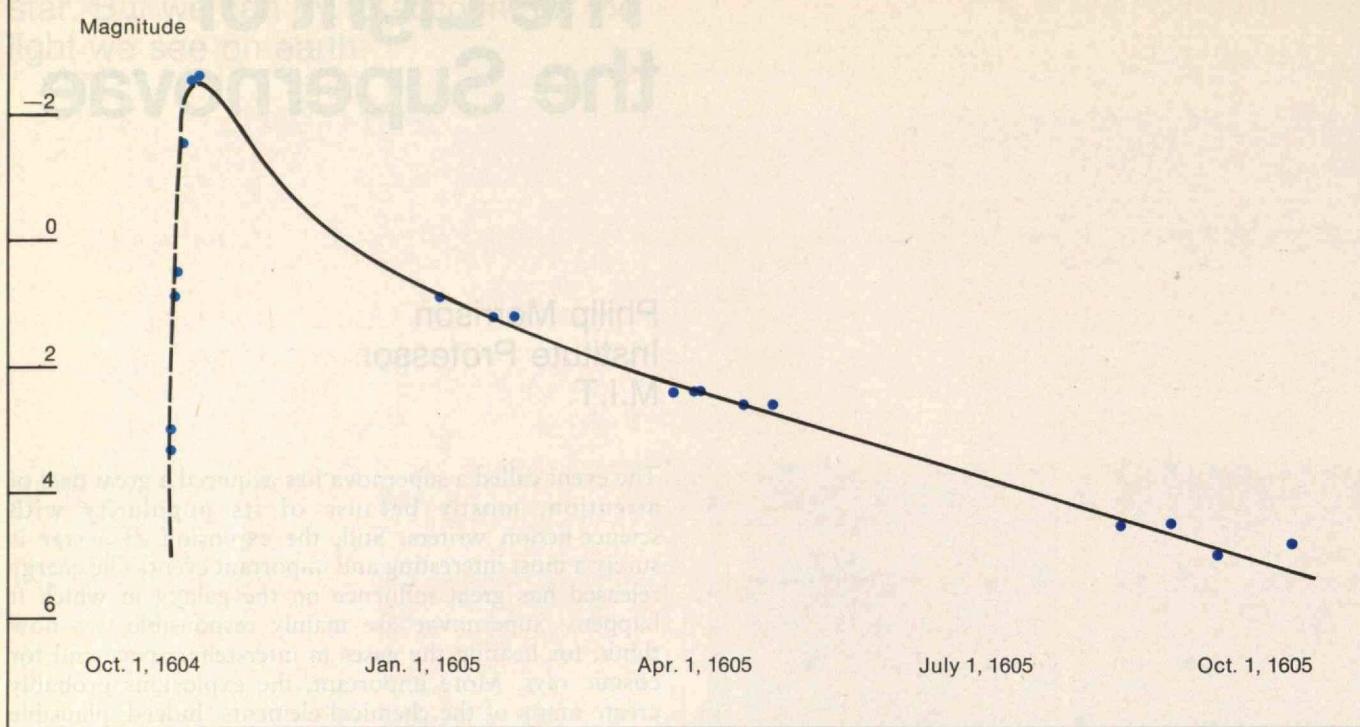
Are we then helpless? No, but we ought to be more modest. We cannot begin by guessing the cause of the explosions. We must work with what we see — the light in the sky that makes us interested.

The Career of a Supernova

The photographs on these pages were taken through the telescopes on Mount Wilson, the first on November 29, 1926, the last on November 24, 1938. The patch of darkness on each negative is a galaxy, not a very bright or interesting galaxy, but a modest one a few million light-years away, a little beyond the "local group" of galaxies which includes ours. At the left hand edge of the galaxy is a dark spot, not quite so dark in the later images as it was in the second and third. In fact, the later images have been



progressively darker; evidently, the observers were trying to record an object that grew progressively dimmer, and were increasing the exposure time for their plates. Even so, the supernova is almost absent from the rightmost photograph, taken on November 23-24, 1938 through the hundred-inch telescope. The photographs were provided by John R. Bedke of the Hale Observatories, and are reproduced here with the Observatories' permission.



The light-curve of a supernova. The vertical axis plots magnitude — the supernova's luminosity, on a logarithmic scale. The horizontal axis plots time. Points on the chart represent Johann Kepler's visual observations of a new star in our galaxy that appeared in 1604, but faded in a few months. The solid line, however, was not drawn to fit those points. It is the light-curve

(adjusted in height) of a 1937 supernova in another galaxy, estimated by W. Baade and F. Zwicky to be about three million light-years distant. The galaxy is a small one, and thus did not seem promising for supernovae, but the researchers included it in their observing schedule at Mount Wilson, and a bright supernova appeared in less than a year.

overexposed in an effort to find the spot, but it's hardly there any more.

Looking at these photographs is not very exciting. But putting in some numbers reveals that the images record a most extraordinary event. A galaxy contains perhaps 10^{10} stars — even a small galaxy like that one. In the second photograph, the galaxy's new star is not dimmer than about a tenth of the galaxy. Certainly, a few per cent of the galaxy's luminosity is in that spot. Thus the photographs reveal that something suddenly came into existence, as bright as a billion ordinary stars, but faded in a few months' time, or perhaps a few years' time, if one looks very carefully at later photographs.

Such events are supernovae. They are reported a few times a year by organizations, the Hale Observatories in particular, that expose photographic plates to the sky from month to month. The images are made to coincide, then illumination is rapidly switched from one to the other. This produces a flickering effect for any place that is bright in one image and dim in the next. The flickers are always found in the same circumstance: always quite near the image of a galaxy. It is implausible that they should occur near earth, and coincide with galactic images just by chance, because the area occupied by galactic images is very small compared to the entire area of the plates. Evidently, then, supernovae are stars that become as bright as 10^8 or 10^9 stars, last a couple of months, and then die away.

What is the energy of such an object? The familiar unit of power is the kilowatt, and the familiar unit of household energy is the kilowatt-hour. We introduce two new units: the "sun-power," which equals the luminosity of

our sun, and the "sun-year," which equals the sun's energy output for one year. In these terms, the output of a supernova is about 10^9 or 10^{10} sun-years. Now, an ordinary star's lifetime is a few times 10^9 years. Therefore, a supernova spends its entire energy currency in one big zap, lasting only one or two years.

We have known about 200 or 300 of these events at the time of their explosion. We also see a considerable number of objects in the sky — 50 or 100 — that were probably supernovae a thousand, or ten thousand, or a hundred thousand years ago. We can be certain of this only in the two or three cases for which somebody saw the explosion. In late June, 1054 A.D., for example, a star appeared that had never been seen before. Chinese astronomers could see it by day for a month, and it remained visible at night for a year or two before disappearing. This is exactly what a nearby supernova would look like. Of course, the astronomers of 1054 A.D. had no telescope or photographic plates. They simply recorded that the star appeared in a certain constellation, describing its position with words. When we look at the same place in the sky, we see an expanding gas shell that we call the Crab Nebula, and calculating backward, we find that the shell contracts into a point at 1100 A.D., plus or minus 50 years.

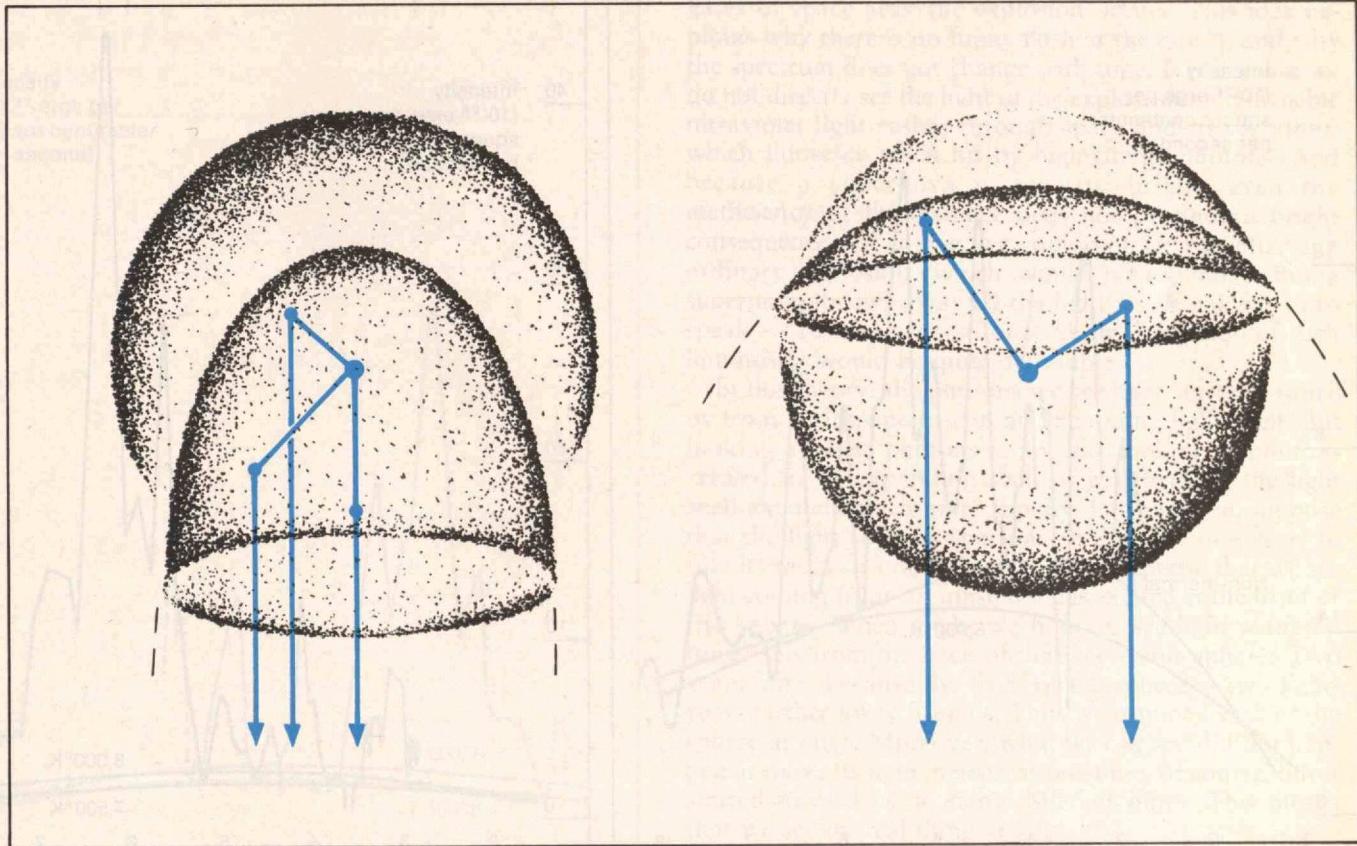
We can study such supernova remnants because there are many of them in the sky at any given time. But the remnant is not the explosion, so there is a huge gap in our observations: we see supernovae come into being, last for two years, and die away. We also see supernovae remnants hundreds or thousands of years later. But we have no knowledge of what goes on during the intervening

centuries. We certainly cannot see the shell of gas beginning to expand. Its diameter is very small at first, and the shell is very far away. We can only become aware of it after it has expanded for a thousand years, and has become a large cloud in the sky, emitting radio, x-ray, and infrared frequencies. We might then be able to observe it, but even at this stage we see only those supernovae remnants in our own galaxy in any detail. As for supernovae themselves, we have never seen one in our own galaxy through our telescopes. This is just bad luck. There have been none since Galileo looked at the sky with a telescope for the first time, in 1609. But there was a beauty in 1604, and it was knowingly observed by Kepler — no slouch as an astronomer — who therefore has the last good data on a supernova in our galaxy.

Many people in Europe had been watching the sky in 1604, because there was a conjunction of Jupiter and Saturn; the planets were in a "fiery" zodiacal sign, an event significant for astrological reasons, which recurs only every 800 years. So Europe was measuring and watching, but Kepler did not watch one night, because it was cloudy in Prague. Friends reported to him, however, that the clouds had opened up briefly, revealing not only two planets, but also a third one — very bright, perhaps brighter than the others. On subsequent nights, Kepler

himself saw it, and he realized a remarkable thing: it was a new star. Planets are close enough to us so that the earth's revolution around the sun produces a noticeable change in the angle at which we see them. But this object did not move relative to the background of stars. Kepler remembered that his teacher, Tycho Brahe, in the year 1572, had also seen a very bright object appear in the sky — one that also did not move, that remained very bright for some time, and then died away. Tycho had found a way to measure its brightness; on each night, he had chosen a nearby star that appeared equally bright, so when the new star had disappeared, there remained in the sky a record of its career. Tycho had recorded his observations in words — graph paper and graphing not having been invented.

Kepler's notes give us what is called the light-curve of the supernova of 1604, which is shown at the left. The points on the illustration are Kepler's; they plot the supernova's "magnitude" — that is, its luminosity, on a logarithmic scale that astronomers customarily use. But the curve drawn in the illustration is not at all a line drawn by Kepler, nor is it even a line specially drawn to fit Kepler's points. It is a light-curve for a supernova of 1937, adjusted in height, to be sure, because that supernova was in another galaxy and never became bright



The fluorescent theory of supernova light, proposed by the author and Leo Sartori. The supernova explosion is presumed to release a burst of light that travels outward in an expanding "shell," but that light is invisible on earth, being at frequencies that cannot pass through our atmosphere. What we do see is light that fluorescing gas in circumstellar space emits when the supernova's light hits it. Using this assumption, a geometrical calculation shows that the light we see at any one time travels to us from an ellipsoid, one of whose foci is on the explosion site, the other of which is our eye. But we do not see the entire ellipsoid, because it is very unlikely that photons in the original supernova radiation burst will travel

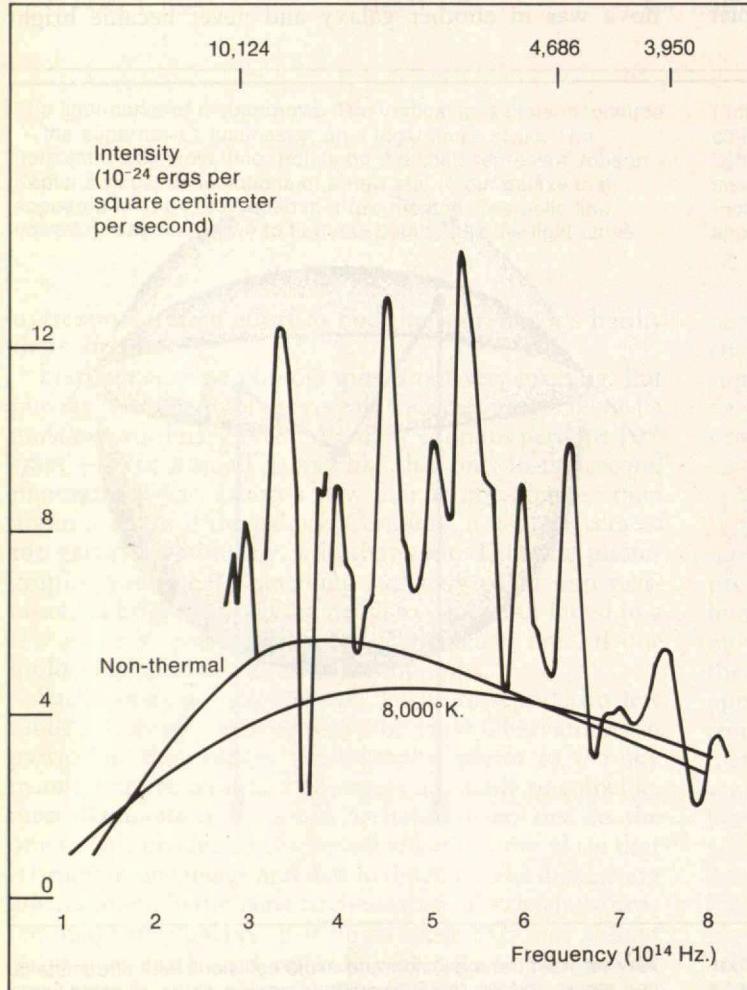
very far from the explosion and avoid collisions with circumstellar gas atoms. In fact, the light-emitting portion of the ellipsoid lies within a few light-years of the explosion. In the illustration, this attenuation of light with distance is crudely represented by a limiting sphere surrounding the explosion site. At times soon after the explosion (left drawing), the light-emitting part of the ellipsoid is both in front of and behind the explosion, but the ellipsoid expands as time passes, and finally we see light only from behind (right drawing). In both cases, the ellipsoid has been distorted for illustrative purposes; in actuality, it would be millions of times longer than it is wide if the supernova were in another galaxy.

enough to be seen by the unaided eye. But seen through a telescope, its relative light-curve was the same as the light-curve of Kepler's star: it rose and fell with exactly the same shape.

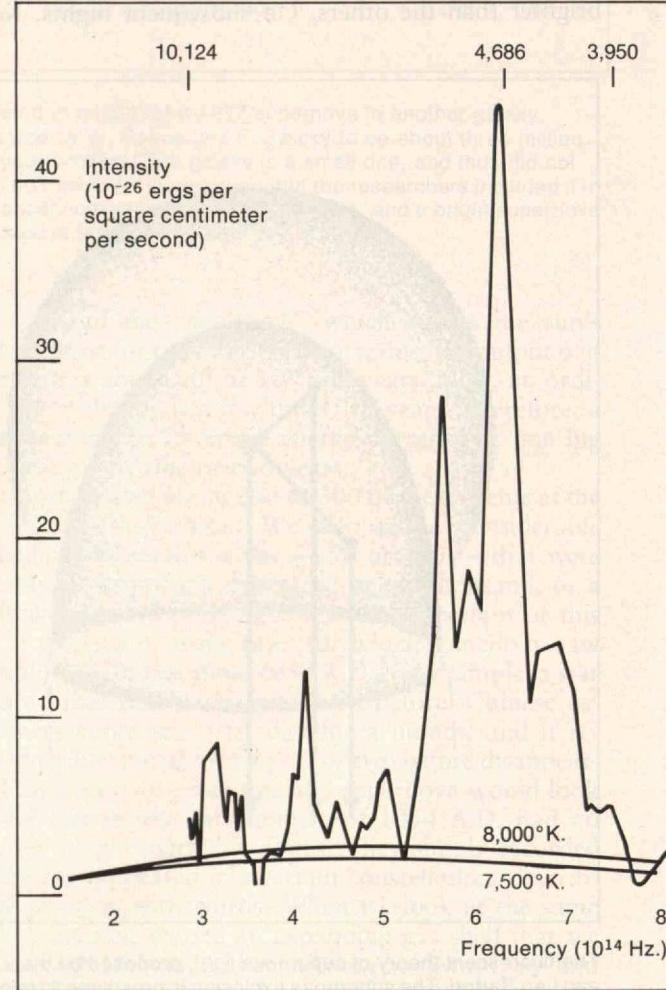
One regularity of this shape is very apparent: supernovae light-curves never have secondary maxima; the curves all monotonically decrease after their first maximum. When we replot a light-curve on a linear, not a logarithmic, energy scale, we see a great peak followed by a long, slow tailing-off. Thus, most of the data do not refer at all to the bulk of a supernova's energy, which appears in the peak and is over in 10 or 20 days, but refer to a long glow, a very regular glow that persists for one or two years after the supernova attains its maximum luminosity. And the glow that Kepler watched for two years beginning in 1604 faded in the same way as the glow in a distant galaxy that Baade and Minkowski watched through the Mount Wilson telescope beginning in 1937. Thus, supernovae are regular phenomena; there is something essential there that can be unravelled. In particular, there must be some meaning to this long, slight tail.

The Fluorescence of Circumstellar Gas

A brilliant theory was put forward in 1958 by a group at the California Institute of Technology. They supposed that supernovae are some kind of nuclear explosion, and that the tail of the supernova light-curve is the result of radioactivity which persists after the explosion, just as fallout persists after a nuclear bomb detonates. The theorists showed that the tail decreased exponentially, as radioactivity does, and they calculated that a 55-day half-life provided the best fit to observations. Now, in hydrogen-bomb tests in the mid-1950s, a new isotope had been discovered — californium 254, which has the required half-life, but also has this remarkable property: 254 is fairly heavy, but nevertheless Cf^{254} is the lightest element whose main mode of decay is by spontaneous nuclear fission. That singled it out, because fission releases 200 or 300 million electron volts (Mev), whereas emission of alpha particles and the like, which characterizes most radioactive decay, releases only about 5 Mev. Therefore, if there is any Cf^{254} in a mixture of radioactive materials, the emitted energy will attenuate with a 55-day half-life, since much more energy is coming from fission



Three spectra for supernova 1972e, the brightest one observed in 37 years. Each curve has been corrected for the absorption of light by the gases in our galaxy, and broken lines indicate regions of large uncertainty in the data, which were provided by R.P. Kirshner, J.B. Oke, M.V. Penston, and L. Searle, working at the Hale Observatories. The vertical intensity scales are linear, not logarithmic, allowing each spectrum to be considered as a sum of two parts: a collection of discrete peaks, rising above a pedestal of continuum radiation. The pedestal is believed to be energy



radiated from an expanding shell of gas, and some of the peaks are believed to derive from fluorescing gas in circumstellar space. Three numbers at the top of each chart mark the positions (in wavelength) of three peaks, or "lines." Two of them — at 10,124 Å and 4,686 Å — are probably emitted by fluorescing once-ionized helium atoms in space. The third — at 3,950 Å — is probably associated with once-ionized calcium atoms in the expanding gas shell.

The leftmost spectrum is an early one, taken 37 days after maximum luminosity. Two curves (dotted lines) have been drawn

of Cf²⁵⁴ than is coming from any dozen isotopes with various half-lives that happen to be in the mixture.

Accordingly, the theorists decided that a supernova makes californium 254, which somehow turns itself into the glow that we see. The trouble is that nobody could understand how radioactive californium can make visible light. Moreover, it developed that supernovae light-curves were not true exponentials, and if one somehow fit an exponential drop to the data, it was not always a curve with a 55-day half-life. It also turned out that if supernovae made very much Cf²⁵⁴, our galaxy would contain much more of its fission products than is found by several measurements. Thus the theory, attractive as it was, is gone. There may be a little Cf²⁵⁴ produced by supernovae, but it is not responsible for the light-curve.

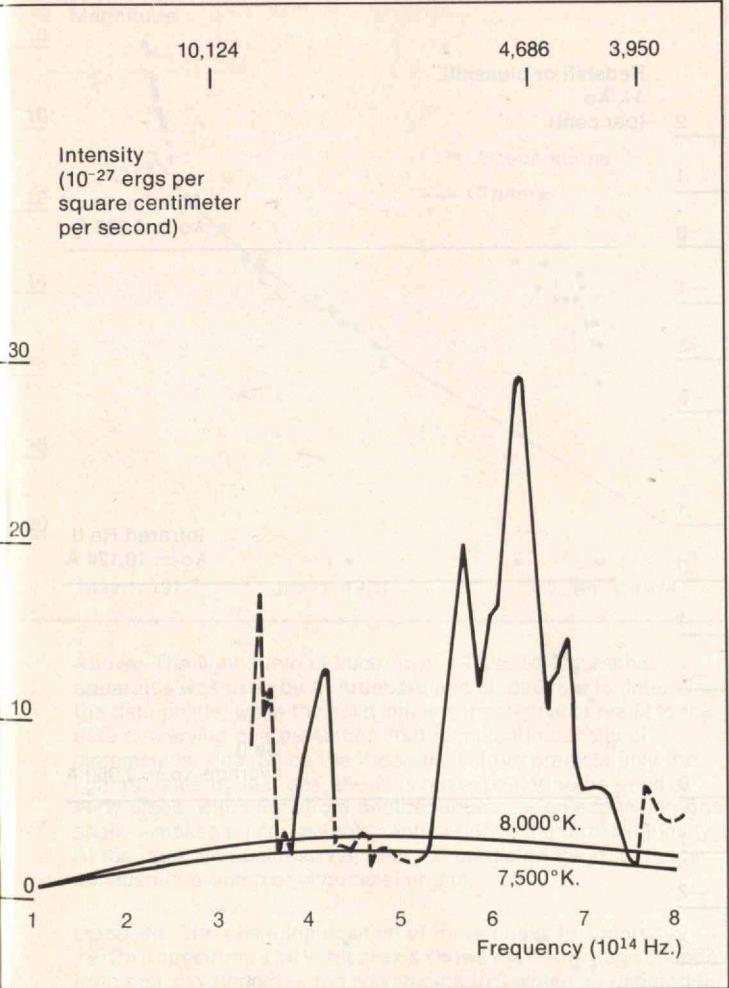
In searching for another theory, let's naively ask: What does an exploding star look like? There should be an expanding shell of gas, of course, which takes away most of the mass from the stump of the star. We see this happening in the supernovae remnants, such as the one corresponding to Kepler's star. Spectral lines in the light from these expanding gas shells change their frequencies, just

as the pitches of moving train whistles do. From this so-called "Doppler shift," we calculate speeds for these gases on the order of a twentieth or a thirtieth of the velocity of light. That is on the order of 10^4 kilometers per second — a prodigious speed, indicative of a tremendous explosion. But something else probably rushes out of the explosion faster: a shell of light, that starts outward at the same time as the gas shell, but travels twenty or thirty times more rapidly. Therefore, if we, positioned at a vast distance, see anything at all of a supernova's early existence, quite possibly what we see is not expanding matter, but rather has something to do with a shell of light — electromagnetic radiation — that emerged from the explosion.

We on earth cannot see any light from the sky at higher energy than about four electron-volts (eV) per photon; the atmosphere cuts it off until gamma-ray energies. Thus, if supernova radiation has energies of 10, 20, 30 or more eV per photon, we will never see it. Yet we do see a glow that lasts for a long time. As we shall find, the glow's spectrum is rather odd: simpler than we would expect, but difficult to recognize in any way. Moreover, as the glow dies away, its spectrum does not change; the distribution of frequencies we see at the end is the same as it was at the beginning. Perhaps what we see is not the light of the supernova itself, but light that is excited in the gases of space after the explosion occurs. This idea explains why there is no funny flash at the outset, and why the spectrum does not change with time. It is because we do not directly see the light of the explosion: that invisible ultraviolet light rushes through space and strikes atoms which fluoresce when hit by high-energy photons. And because a supernova is so very bright, even the inefficiency of fluorescence does not preclude a bright consequence. Of course, we could not see this after any ordinary explosion, which would be too faint. But a supernova throws away all the light in the galaxy, so to speak — 10^9 sun-years at once. A small fraction of such luminosity would be quite detectable.

In this theory, the photons we see have started toward us from various points on an expanding light shell. But looking at these photons is not like looking at photons created in an expanding shell of gas, because the light shell expands much more rapidly. For example, suppose that the light shell has been expanding for one year, so that its radius is one light-year. Now suppose that we see light coming from circumstellar gas excited at the front of this sphere. When might we hope to see light scattered toward us from the back of that very same sphere? Two years later, because the back of the sphere is two light-years farther away from us. Thus we cannot see all of the sphere at once. Moreover, what we *can* see did not happen at once. Its light *arrived* at one time, of course, but it started toward us at many different times. This means that we see no real thing at all.

Everybody knows this. The man on the street knows that he sees the Andromeda Nebula, for instance, two million years after it has given out that light. It could be that those stars have changed, or that they have gone away. But there is more: the Andromeda Nebula whose photograph we admire in the magazines never existed, and could not possibly exist. The nebula is 100,000 light-years across, and therefore we see the front edge of it 100,000 years closer to us in time than the back edge. Now it is true that if the stars do not change rapidly, this makes no difference. And astronomy usually deals with



in an attempt to fit the continuum radiation; as shown, an 8,000°K. black-body curve does not do this as well as a non-thermal curve. The middle spectrum was taken 246 days after maximum. The continuum radiation has diminished relative to the discrete lines, and the helium line at 4,686 Å dominates. The rightmost spectrum was taken 181 days later — 427 days after maximum. The luminosity has dimmed enormously, but the appearance of this third spectrum is remarkably similar to that of the second. In both, the continuum radiation is compared with two black-body curves.

long-lived phenomena. But a short-lived phenomenon like a supernova burst cannot be treated that way. The burst's geometry, though, remains very straightforward: A photon travels outward from the explosion to a place where a gas atom in space absorbs it. Almost immediately, a second photon is emitted by that atom at a characteristic frequency, and the second photon travels to the observer's eye. The net path is a dogleg from the supernova to the scattering point, and from there to the observer. Now we imagine that the supernova produces an instantaneous burst of invisible high-energy light, and that an observer can see only the secondary visible light emitted by the gases of space. Therefore, an observer sees light along a surface such that the time it takes light to reach him from the explosion via the surface is the same for all directions. That is well known to be an ellipsoid—not a sphere. With time, this ellipsoid expands. But its foci are fixed: one is the site of the supernova explosion, and the other is the observer's eye.

This produces several strange results. The light shell created by the explosion will weaken as it travels through space—geometrically (as one over the radius squared), because the shell expands, but also because of absorption by the fluorescing gas atoms. This second kind of attenuation increases exponentially with distance from the explosion. Therefore, we expect an exponential to figure somehow in what we see: since light that produces fluorescence in atoms far from the explosion has taken a long time to get there, and has been progressively enfeebled in flight, there is a tendency to an exponential drop of energy with time that matched the supernova light-curve when we did the full calculation.

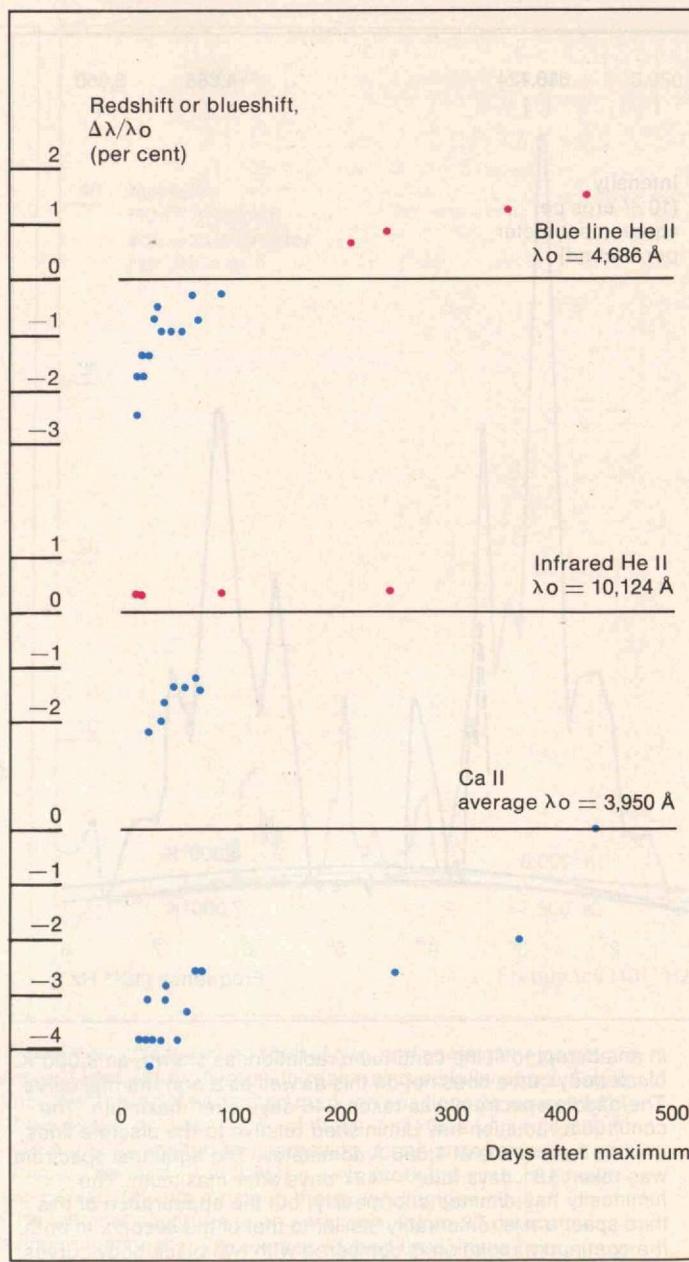
A second result was more unexpected. Consider the light we see t seconds after the supernova first appears in the sky. This light reaches us t seconds after the light that travels to us directly from the explosion. During this extra time, it must travel an extra distance ct , where c is the speed of light. In particular, some photons travel backward from the explosion, and then are scattered forward toward us. They must therefore have gone backward a distance $\frac{1}{2}ct$, and then forward over the same distance. For example, one year after we first see the supernova, we see light from half a light-year behind the explosion. This corresponds to the backpoint of the ellipsoid, which is the point on the ellipsoid closest to the site of the explosion. But we also see the rest of the ellipsoid, which extends forward in space—except that we cannot see fluorescence created far away from the explosion, because there is virtually none: by then, all the supernova's light has been absorbed.

One way to characterize the absorption is in terms of λ , the "mean free path," or average distance a photon travels from the explosion before it collides with a gas atom. Almost no light gets farther away from the explosion than a few times λ . Now λ is a fixed number; it depends only on the density of the circumstellar gas. At early times—say, during the first few weeks— λ is large compared to $\frac{1}{2}ct$, and we see fluorescence from a relatively large area of the ellipsoid's surface. At later times, though, λ is small compared to $\frac{1}{2}ct$, so we can see only the fluorescence that comes from the near neighborhood of the backpoint. The rest of the ellipsoid is so far from the explosion—so many λ 's away—that there is no light left to induce any fluorescence. This is a strange, unexpected asymmetry. It is shown very schematically in the illustration on page 23.

The Supernova of 1972

Armed with this point of view, we asked what sort of spectrum would occur. We first considered the light from fluorescing gas in space. What is characteristic of this gas? It is very thin stuff—individual atoms that never collide and do not grow hot. Such things emit energy at specific frequencies, so our spectographs should record lines characteristic of whatever atoms are there, provided there is energy in the original explosion to excite them. This spectrum should die away at the rate we calculate in terms of the inverse-square law plus the exponential. We should also see light direct from a very different source: the supernova's expanding shell of gas, which initially is very dense and hot, but thins out and cools as it expands. Here, one expects a much more complicated spectrum—probably a visible continuum of radiation in addition to discrete lines, because of all the collisions while the gas is dense.

Let's now look at a supernova's spectrum. On May 5, 1972, the people at Palomar observed a very fortunate event: the brightest supernova since 1937. It was not



equally bright, but in the intervening years, the apparatus in California had been improved a great deal, so the measurements could be made much more accurately. Leo Sartori and I, who had made our theory somewhat earlier, decided to use this supernova as a test case. We — Leo Sartori, now at the University of Nebraska, Bella Chiu, an M.I.T. researcher, and I — were able to account for many aspects of the data, and we feel rather encouraged.

The leftmost illustration on pages 24-25 shows a spectrum of the 1972 supernova, taken 37 days after maximum luminosity. Near 4,686 Angstroms is a peak that we can identify as being due to fluorescing atoms of once-ionized helium (denoted helium II). The other peaks have not been identified, but we assume that many represent other emission lines in the circumstellar medium and in the expanding shell. These peaks stand somewhat above a broad pedestal of continuum radiation that we believe is due to the expanding shell of gas. Are we justified? The middle illustration shows a much later spectrum, taken 246 days after maximum. Now the spec-

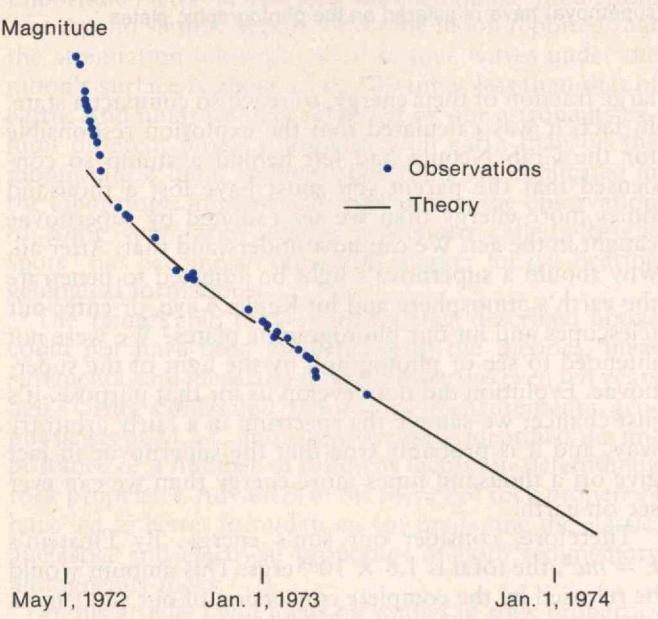
trum is dominated by the peaks — the pedestal has gone — and the helium II line near 4,686 Å is by far the main contributor. Presumably, the gas shell has thinned and cooled with expansion, so the continuum contribution to the spectrum is dim relative to the fluorescent contribution. The rightmost illustration shows the spectrum 427 days after maximum. A comparison with the middle chart shows that the supernova's spectral appearance has remained remarkably stable over a time span of almost 200 days. The most prominent features have maintained their relative intensities, though each has declined absolutely by a factor approaching 100.

The deviation of the helium II line from a wavelength of 4,686 Å is its Doppler shift. If the emitting atoms are moving away from us, the line should be redder than 4,686 Å; if the atoms are moving toward us, the line should be bluer. The illustration on the facing page shows what happens to that line as time advances. It begins by looking blue, but then it reddens — in fact, it continues to redden indefinitely. Now, if we were looking at a shell of gas as it expands and thins out, we would expect to see light from the front of the shell (that is, from gas moving toward us) and from the back of the shell (gas moving away from us). On the average, there should be about as much gas moving toward us as away, so there would be no net Doppler shift. Initially, however, the front of the shell would hide the back, because the gas is dense while the shell is young. Therefore, we would see a blue-shifted line that gradually moved to a position showing no shift at all. That is not what we see here. But our theory accounts for the reddening that we do see as the supernova's glow fades. Long after the explosion, we see only the fluorescing gas behind the supernova. And because it is behind the supernova when it is hit by a high-energy photon, that gas is probably moving away from us when it fluoresces. The illustration also shows the Doppler shift of a particular peak that appears to be part of the expanding gas shell's direct spectrum. At the very least, we can argue that the helium II line and this peak have quite different origins.

What about the light-curve? The line in the illustration on this page is our theoretical light curve, fit to the data by varying a single parameter which measures the density of fluorescing gas in space. We make the simple assumption of uniform gas distribution; that is, of course, naively simple, but one expects it to be fairly uniform. Moreover, since we do not see light from any one place but rather from the surface of an ellipsoid, supernovae light curves must be rather smooth; they are always integrating over large regions of space. We can expect deviations from the theoretical curve if there are deviations in gas density. And because the expanding gas shell contributes light during the supernova's early career, we do not expect the theoretical curve to work very well at the left of the chart. (The drop in early 1973, by the way, is unprecedented. If it is real, it should be due to a bump of circumstellar gas. In any case, a later datum appears to have returned to our theoretical curve. The Palomar group was able to get one additional point, but we do not have it at this writing.)

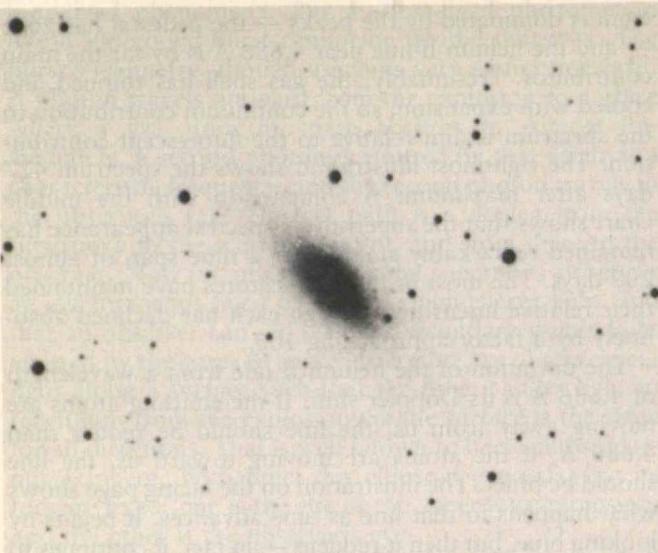
The Energy of the Supernovae

Why did Kepler see such a simple behavior — a simple light-curve that inspired our theory? By chance, if you like. The human eye grown accustomed to the dark and the special photographic apparatus used in astronomy record very similar pieces of the electromagnetic spectrum.

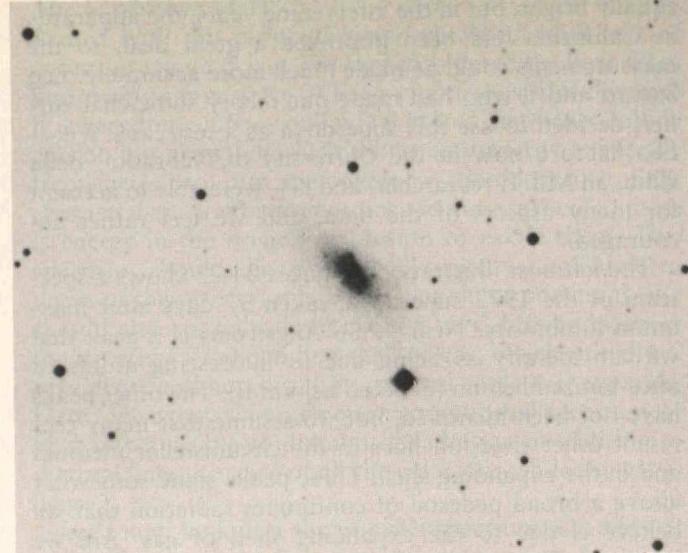


Above: The light-curve of supernova 1972e. Photographic apparatus was used by A. Ardeberg and M. deGroot to determine the data points, while the solid line is a theoretical curve fit to the data by varying one parameter that reflects the density of circumstellar gas. Since the theoretical curve predicts only the light radiated by that gas, the fit is not expected to be good at early times, when light from another source — an expanding gas shell — makes an appreciable contribution to the total luminosity. At the right, one point strays from the predicted trend, perhaps because of a bump of circumstellar gas.

Opposite: The changing position of three peaks in supernova 1972e's spectrum. The vertical axis shows the percentage change from rest wavelength — the wavelength that would be radiated by atoms at rest relative to the observer. Positive percentages are redshifts, corresponding to motion of the emitting atoms away from us; negative percentages are blueshifts, corresponding to motion toward us. The two fluorescent helium lines behave quite similarly (as far as late points are available for the 10,124 Å line), whereas the calcium peak reaches zero shift much later, and gives no indication of any redshift. It can at least be argued that the first two lines derive from a different type of source than the third. Individual wavelength estimates are admittedly rather uncertain, though, by ± 1 per cent.



Supernova 1972e, used to test the theory discussed in this article. It appeared in galaxy N.G.C. 5253 in May of 1972. The photograph at the left is a portion of a Palomar Sky Survey plate showing the galaxy; it was taken in 1958 at the Hale Observatories and copyrighted by the National Geographic Society. The photograph



at the right shows the supernova near its maximum luminosity, and is reproduced with the permission of the *Publications of the Astronomical Society of the Pacific*. The center of the galaxy is much brighter than the periphery, so only the center (and the supernova) have registered on the photographic plates.

So, given the spectrum of a supernova, the eye and the camera see about the same thing. And it is the simplest possible thing to see: the helium II line, which is why our theoretical curve works well, even if we look at supernovae with different kinds of instrumentation.

As we have seen, the helium II line is the most prominent feature in a supernova's later spectrum. The line results when a once-ionized helium atom is hit by an ultraviolet photon and gives off a visible photon. But we know the physics of the fluorescence of simple atoms, and this is one of the simplest: a helium atom with one of its two electrons gone. We can calculate with great reliability the probability that if this atom is hit by a photon of a certain energy, it will produce a photon of a second energy. It turns out that the helium II fluorescence we see is only about one per cent efficient. Thus the exciting light that comes out of a supernova must total a hundred times more energy than the light our eyes or cameras record. More than that, the light that helium II shows us is proportional to that fraction of the light from the explosion that had enough energy to excite a helium II atom's electron to the necessary level, but not so much more that the electron would be ionized away. That defines only a small energy band: between 50 and 54 eV. And that band is important to us only because of the circumstance that we can see the helium II line that it excites. There must be much more energy in the supernova explosion than happens to be in that 50-54 eV band. In total, there might be a thousand times more energy coming out of a supernova than we can see! That is a striking conclusion, one which might cause the theorists of the supernovae to tremble, because they cannot account well for even the energy we see, let alone a thousand times more.

The only pleasant thing about this thousand-fold discrepancy came a few years ago, when a pulsar — a pulsing radiation source — was discovered in the Crab Nebula. Pulsars are now believed to be rotating stars composed of neutrons. They are so small — the one that powers the Crab Nebula is ten miles across — that their parent stars must have collapsed utterly, and released a

large fraction of their energy, to reach so compact a state. In fact, it was calculated that the explosion responsible for the Crab Nebula had left behind a stump so condensed that the parent star must have lost a thousand times more energy than we see radiated by supernovae caught in the act. We can now understand that. After all, why should a supernova's light be adjusted to penetrate the earth's atmosphere and hit Kepler's eye, or enter our telescopes and hit our photographic plates? We were not intended to see or photograph by the light of the supernovae. Evolution did not develop us for that purpose. It's just chance; we sample the spectrum in a fairly arbitrary way, and it is probably true that the supernovae in fact give off a thousand times more energy than we can ever see on earth.

Therefore, consider our sun's energy. By Einstein's $E = mc^2$, the total is 1.8×10^{54} ergs. This amount would be released by the complete conversion of our sun's mass to energy, and the amount would be greater for a more massive star. Now, we on earth measure that a supernova gives off a little less than 10^{50} visible ergs. But if there is a thousand times more energy given off than we can see, or our photographic plates can record, the supernova's energy increases to 10^{53} ergs, a fairly large proportion of the total energy available. Thus, if our argument is correct, the supernova's theorists must seek a mechanism that turns a star into a neutron star — a giant nucleus — with a more efficient energy conversion than any reaction we know among the nuclear particles on earth or in our sun.

Philip Morrison received his B.S. from the Carnegie Institute of Technology and his Ph.D. in theoretical physics from the University of California at Berkeley. He taught physics at San Francisco State College and the University of Illinois before joining the Manhattan Project in 1943. After the war, he joined the physics faculty of Cornell University. Dr. Morrison came to M.I.T. as a visiting professor in 1964, and accepted a permanent faculty appointment the following year. He was named an Institute Professor in 1973. In recent years, Dr. Morrison has been conducting research in astrophysics and cosmology.

Using Rock Physics to Search for Petroleum

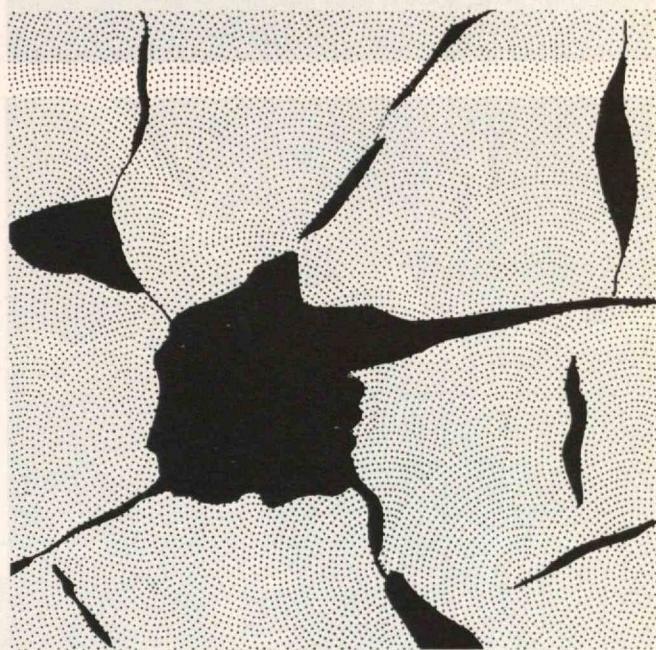
The importance of understanding the physical properties of rocks has been vividly highlighted by a number of experimental findings over the last few years. For example, geophysicists have discovered that the seismic velocities of sound waves in the earth's crust change before an earthquake — a phenomenon that has become an important factor in research on earthquake prediction. The Apollo seismic apparatus on the moon reported that the attenuation (absorption) of seismic waves under the moon's surface is about 10 to 100 times less than that of earth. And lunar samples retrieved by our astronauts exhibit different physical properties on earth than on the moon, unless lunar vacuum conditions are duplicated in the laboratory. In petroleum exploration the observation of some very large seismic reflections called "bright spots" has become an important marker for gas-bearing geological formations.

The remarkable rock characteristics described above could not have been predicted with the theories, measurements, and ideas about rock properties even ten years ago. Using controlled laboratory measurements geophysicists at M.I.T. and elsewhere have identified the importance of a number of different factors in determining rock properties. Advances in the theory of rock properties have led to better formulations for predicting the elastic, anelastic, and electrical properties of both sedimentary and igneous rocks.

In this article, I will focus on studies of rock properties as they contribute to petroleum exploration, outlining the important rock properties, describing laboratory techniques and results, and finally discussing rock property theories relevant to seismic detection of hydrocarbons.

Pores in the Rocks

The physical properties of both sedimentary and igneous rocks are controlled by three important factors — the rock matrix, pore structure, and the fluids saturating the pores. The properties of the rock matrix, or basic rock material, are determined by its mineralogy, and in general can be obtained from its chemical composition. To determine how pore spaces affect physical properties, we must specify both pore shapes and distribution in rock sample. Pores may be equidimensional, elongated, tubular, flat, or very fine cracks. The flat pores and cracks, although they account for a small fraction of total pore volume, have major effects on such rock properties as elasticity and electrical properties. The recent advances in rock physics have been, in part, a result of recognition of these pore effects.

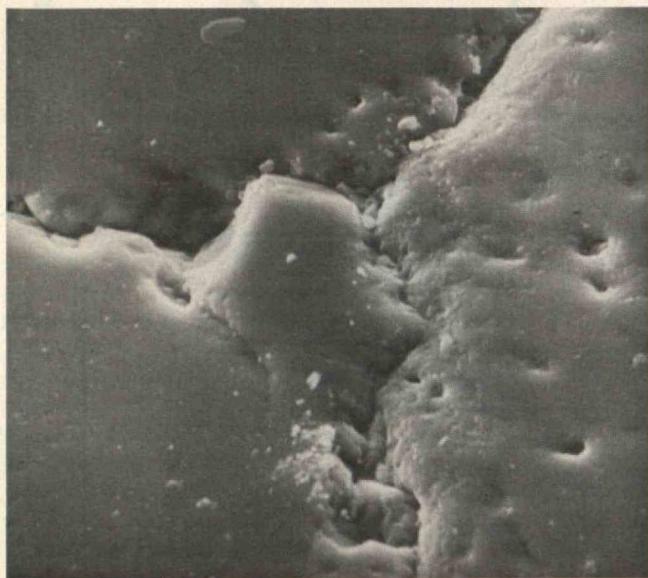
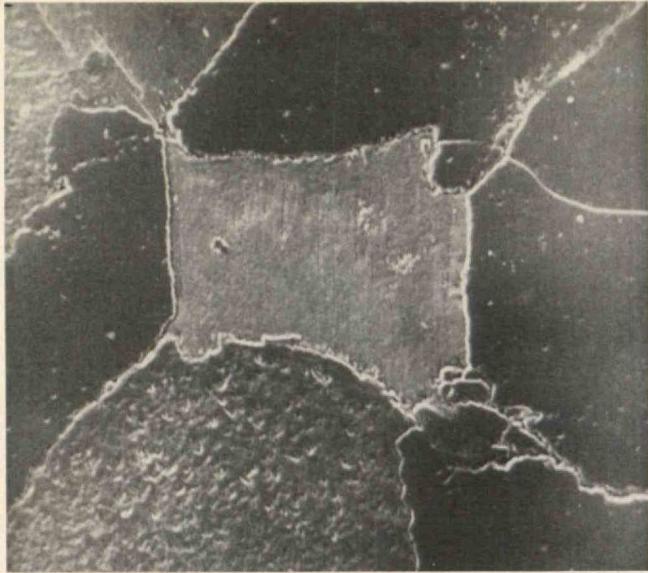


Schematic drawing of a porous sedimentary rock. Dotted areas represent the mineral grains, such as sand grains in sandstone, and the black areas are pore spaces. In a typical petroleum reservoir rock, pore spaces that may be filled with gas or oil may constitute 5 to 40 per cent of the total rock volume. Thus, understanding rock physics means understanding the contribution of solid, liquid, and gas properties to the overall properties of rock.

The saturation of the pores and the properties of saturating fluids are also highly important in determining rock properties. Laboratory measurements performed with rock samples under vacuum or saturated with dry nitrogen, air, water, oil, or gas have shown that fluids control the properties of even the least porous igneous rocks.

Electron microscopy has contributed greatly to the understanding of the pore shapes in rocks, major work in this area being done by Dr. A. Timur and his colleagues at Chevron Oil Field Research Laboratories in La Habra, and by Professors William F. Brace and Gene Simmons at M.I.T.

As you can see from the photographs on page 30, most pores in granite and other igneous rocks consist of fine spaces and cracks, rather than equidimensional pores or cavities — what we call vugular pores. However, in sedi-



These scanning electron microscope photographs of granite illustrate the pore geometries of an igneous rock. At low magnification (top) the pore spaces are invisible; at medium magnification (middle) many fine pores intermixed with healing joints are evident; at highest magnification (bottom) still finer cracks in the grains are visible. Low magnification is 1,000 microns across; medium is 110 microns across; and high is 100 microns across. (from Timur, et. al.)

mentary rocks vugular pores make up most of the visible pore space, although inter-grain pores and cracks are present.

Rock Properties in the Laboratory

To study many properties of rocks in the laboratory we must duplicate as closely as possible the conditions existing in the earth's crust. For such widely-used measurements as electrical conductivity, seismic velocities, and seismic attenuation, we must subject the rock sample to hydrostatic pressures corresponding to those in the crust, as well as carefully controlling the saturation conditions and the pore fluid pressures.

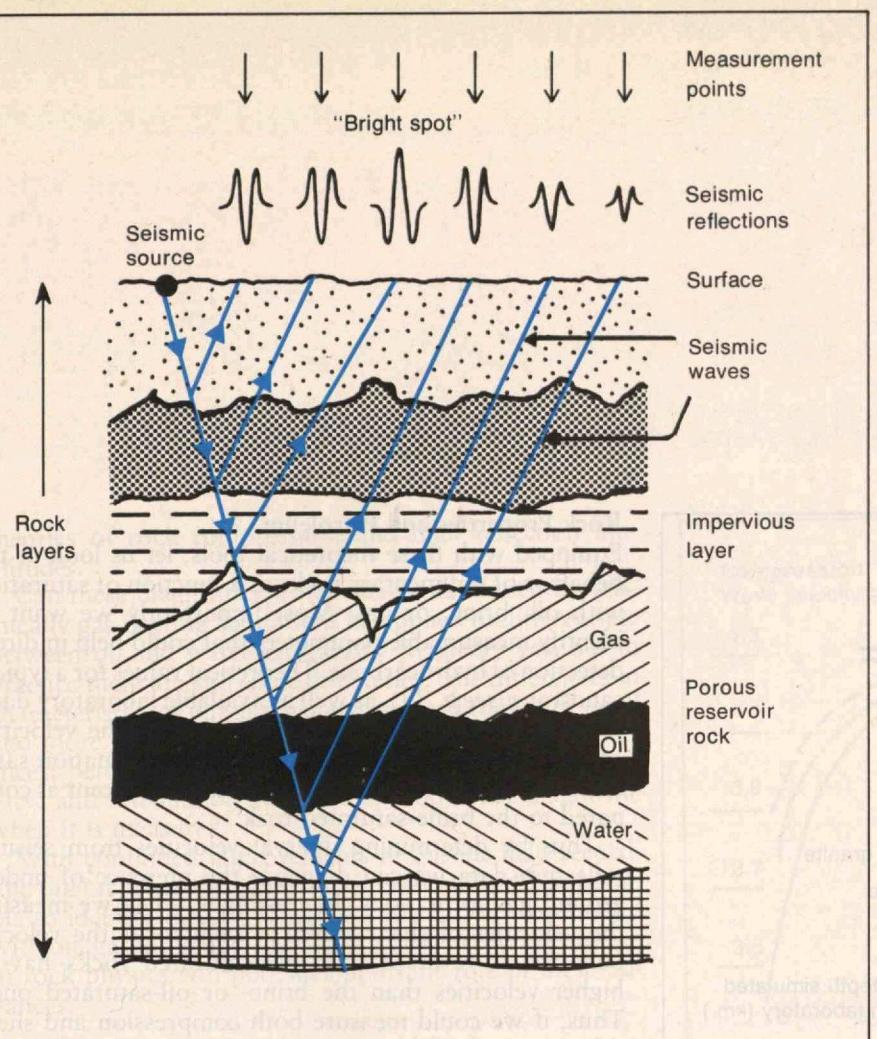
To perform our experiments, we cut rock cores two to ten centimeters in diameter, up to ten centimeters long, jacket them and saturate them or dry them under a vacuum. We then mount them into a holder with proper transducers and pore fluid lines attached, and insert the holder into a pressure vessel (see p. 31). Maintaining the sample under the required conditions, we then make computer-controlled measurements of electrical resistivity, or the velocities of compressional (forward and backward) or shear (back and forth) sound waves, as well as their attenuation. These laboratory data can then be compared with theory and with field data.

Theories of Rock Properties

In developing successful theories of rock properties, merely averaging effects of matrix properties, pore structure and fluids fails to predict the laboratory observations. So scientists have developed elegant mathematical methods of combining these factors to predict such properties as compressibility, rigidity, anelasticity, and thermal and electrical properties.

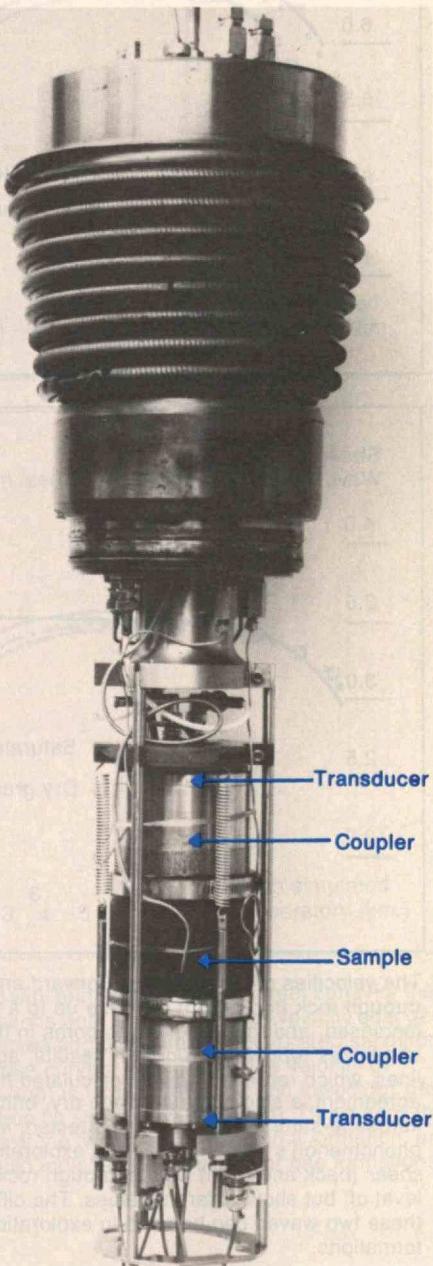
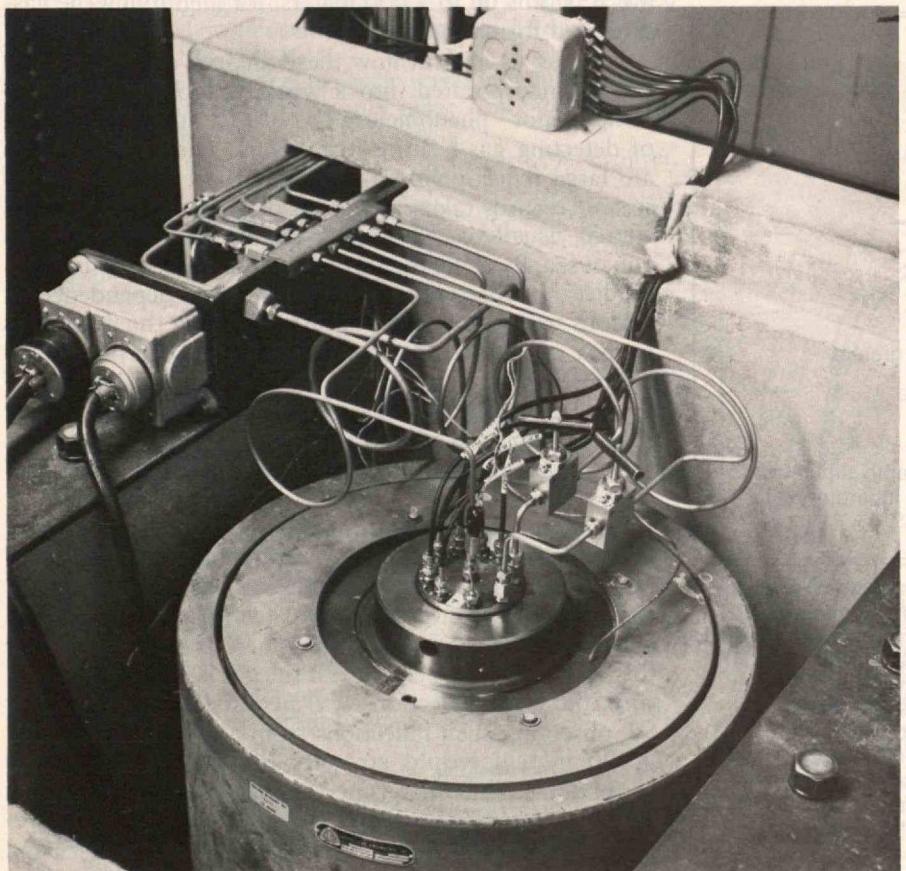
In our own work on the propagation of sound waves in the multiphase (solid, liquid, gas) media of rocks, we mathematically model the rock by a continuous matrix, a spectrum of pore shapes ranging from spherical to very thin cracks. Saturating fluids may be viscous or non-viscous, liquid or gas. When compared with laboratory measurements, this type of modelling has done quite well, as you can see on page 32. Both theory and laboratory data on pressure effects on rock properties predicts a "levelling off" of property changes with increased pressure after a certain point. This can be explained by the following: As pressure increases the finer pores and cracks close, thus giving rise to a rapid increase in velocities of sound waves in rocks. But at higher pressures the pores and cracks have closed, and the near constant behavior of such properties indicates that we are dealing with the compressibility of the highly intransigent rock matrix itself.

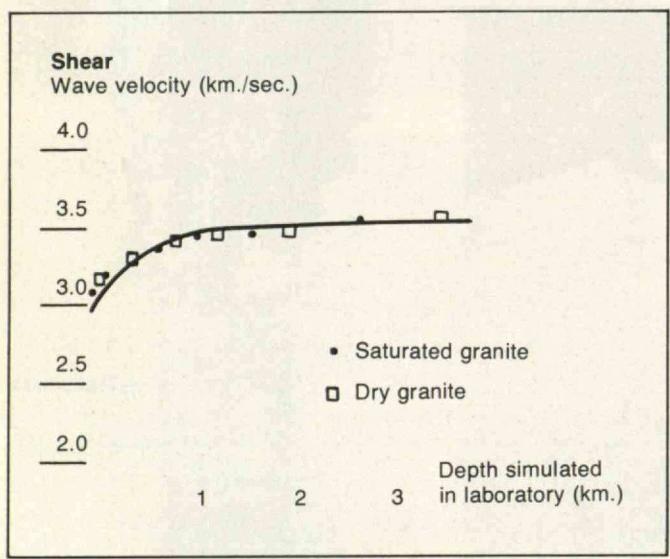
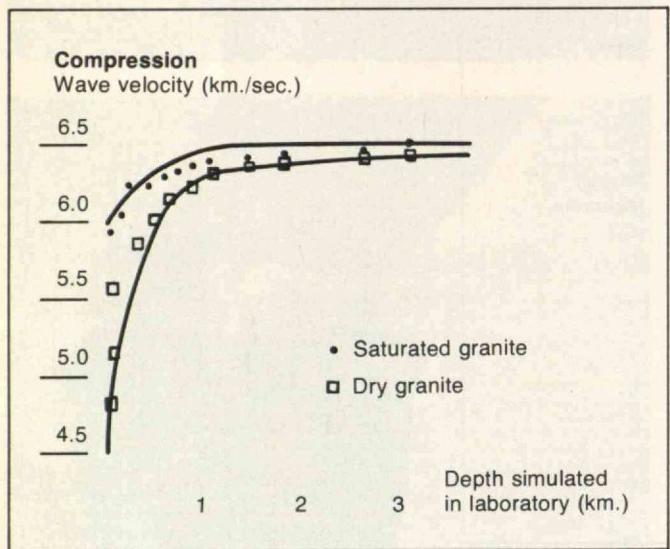
There are two kinds of pressure to be considered in studying rock properties — the confining or overburden pressure that affects the whole rock, and the pressure of the fluid within the pores. This latter pressure may be zero for totally dry rocks, or it could be as high as the overburden pressure. Typically in the earth, the pore fluid pressure is about one half the overburden pressure. Importantly, the rock behavior and pore closings, etc. are controlled by the differential pressure — the difference between the confining pressure and the pore fluid pressure. Thus in all our measurements the pressure calculated to simulate a depth below the surface is the differential pressure.



At the left: Underground gas formations produce a large-reflection "bright spot" in reflected seismic waves. Normally this bright spot disappears in deeper gas deposits because of the increased pressure on the formations. But if the bright spot persists below 3,000 meters, this means the rock pores are maintaining themselves, and thus, that the gas is under high pressure.

Photos below: The photo at the left shows a rock sample holder inside the pressure vessel with electrical and fluid connection lines visible. The photo below shows a rock sample mounted in a sample holder for ultrasonic measurements. (Photos: Rock Physics Laboratory, Chevron Oil Field Research Co.)





The velocities of compression (forward and backward) waves through rock (top graph) increase up to a point as pressure is increased, and then level off as pores in the rock close. The dots and boxes represent laboratory results, agreeing well with the lines, which represent results calculated from theory. Close agreement is also obtained when dry, brine-saturated, or kerosene-saturated sandstone is tested, indicating the phenomenon's use for petroleum exploration. The velocities of shear (back and forth) waves through rock (bottom graph) also level off but show different values. The differences in behavior of these two waves can be used in exploration for natural gas formations.

Rock Properties and Petroleum

Equipped with these theoretical tools, let us look at the behavior of sedimentary rocks as a function of saturation with oil, brine, or gas. Most importantly we want to identify measurable parameters that could help in direct detection of hydrocarbons. Theoretical values for a typical sandstone (see p. 33), as well as available laboratory data, show us that at relatively shallow depths, the velocities of compressional sound waves in a rock formation saturated with gas are lower by more than 10 per cent as compared to the brine-saturated rock.

Thus by determining interval velocities from seismic reflection data we can diagnose the presence of underground gas formations. Interestingly, when we measure the velocities of shear waves in such rocks the velocity behavior is reversed with gas-saturated rocks having higher velocities than the brine- or oil-saturated ones. Thus, if we could measure both compression and shear velocities in the field we would have a strong tool, persisting at depths up to 4,000 meters, for identifying the gas-saturated formations.

Now let us look at how these theories of rock physics can be incorporated into a working tool. Recently the "bright spot" phenomenon has been a powerful method of detecting gas-bearing formations. These bright spots are large reflections that dominate the cross sections of seismic records taken at various distances from a seismic source, usually a charge of dynamite on land and a gas gun at sea. By using the theories of rock properties we can predict the reflection amplitudes and their dependence on various parameters. On page 31, we show the reflections from a gas reservoir and brine-saturated interface schematically. The reflections from the top and bottom of the gas reservoir are large and have reverse polarities. At shallow depths we expect to see very large reflections from a gas reservoir because these formations reflect well.

But because of the compaction of the rock and compressibility of the gas, this effect diminishes with depth. In fact, deeper than about 3,000 meters one would theoretically not expect large reflections or "bright spots" from gas-filled formations. However, there is an exception to this expected disappearance. If the gas is under high pressure, the large reflections will persist to greater depths. So, observing such reflections from a depth greater than 3,000 meters would strongly indicate high-pressure formations. Thus, the valuable high-pressure gas reservoir can be identified by the low-compressional velocities, expected according to our previously discussed

New Techniques in Geophysical Exploration for Minerals

theories of rock compression, and high reflection amplitudes.

Can these diagnostics which enable us to identify seismically gas-bearing formations be applied to differentiate between oil and water saturation? In theory yes, but in practice there are still some difficulties. The differences in characteristics of oil- and water-saturated rocks are small and more is demanded of field data to see these differences; better amplitude and velocity resolution is necessary, and attenuation could be an important diagnostic when it is measured.

With continued improvements in seismic field recording, digital processing, and interpretation, it will be possible to identify directly whether a formation is saturated with oil, gas, or water. Laboratory and theoretical studies in rock physics will play an important role in these advances.

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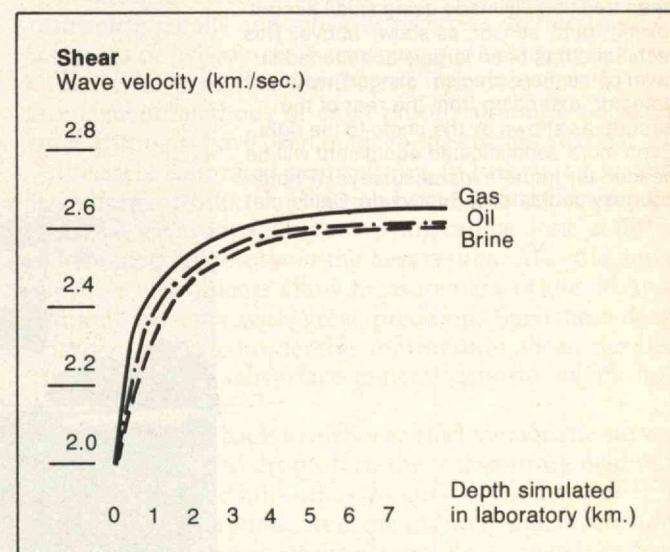
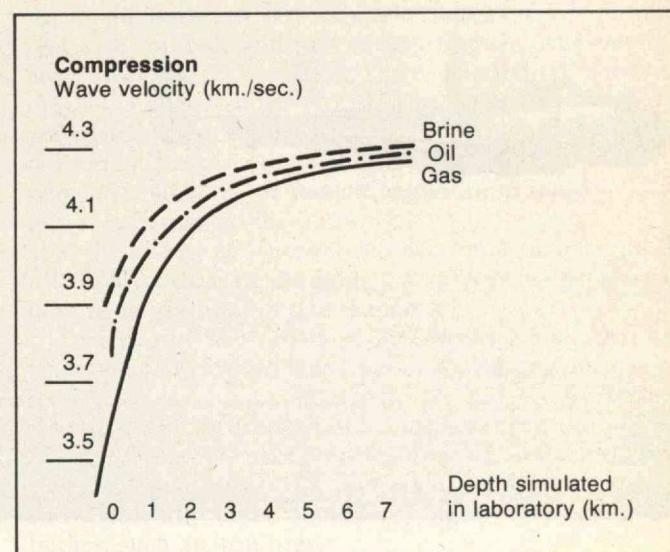
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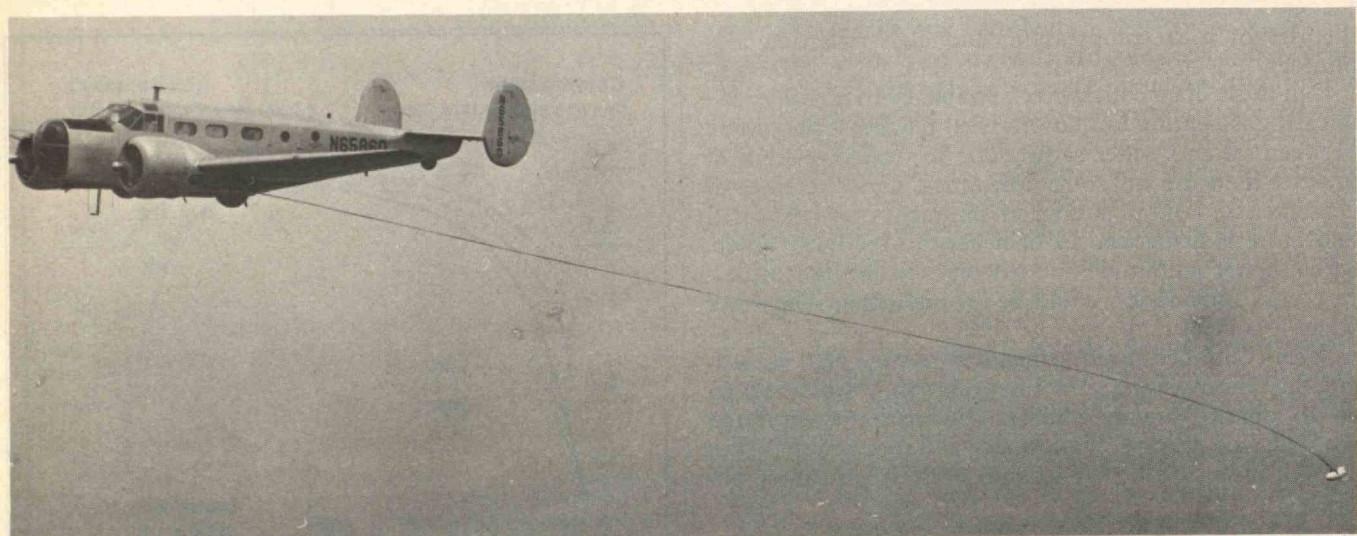
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M. Nafi Toksöz is professor of Geophysics in the Department of Earth and Planetary Sciences at M.I.T. A native of Turkey, he did his undergraduate work in Geophysics at the Colorado School of Mines and received his Ph.D. from Caltech in 1963. Since 1965, he has been a member of the M.I.T. faculty. His research interests cover seismology, wave propagation, rock physics and planetary geophysics.



Sandstone saturated with brine shows very different behavior than does gas-saturated sandstone, in terms of wave-velocity changes, when subjected to increasing pressures. Oil-saturated sandstone is intermediate to those curves. Importantly, the velocity of compression waves (top) is highest for brine and lowest for gas, while the reverse is true for shear waves (bottom). This means that measuring velocities of the two seismic waves in a formation, and comparing them, could indicate the presence of gas formations.

Improved methods for scanning the earth to detect minerals are on the way. But intensive programs will be needed to develop them in time.



Aeromagnetic surveys for minerals have been traditionally made using small aircraft towing "bird" sensor, as shown above. This technique has been largely abandoned in favor of the more precise "stinger" mounted detector, extending from the rear of the aircraft, as shown by the photo to the right. Even more sophisticated equipment will be needed for future mineral surveys. (Photo courtesy geoMetrics, Sunnyvale, California)



New Techniques in Geophysical Exploration for Minerals

Like all resources on this planet, our mineral resources are finite, and unless careful planning is done, we could find our society unexpectedly depleted of certain minerals. Although we have a considerable cushion with respect to minerals such as nickel, iron, and aluminum (see p. 37), in the case of lead, for instance, our supplies are much too low.

And, especially considering that a great many Third World nations will enter the market for minerals, we should definitely undertake a large program to find out exactly how much of the various minable mineral deposits we have on earth.

The exploration geophysics industry has a key role to play in gaining such knowledge, but unless our exploration techniques undergo major improvements all the effort in the world will not yield useful information; in fact, we are already reaching a point of diminishing returns in effort expended versus data obtained.

This article will outline some of the important minerals exploration developments and how they may impact on our understanding of our minerals resources.

Clearly we place too little value on exploration for minerals. For instance, the Canadian mineral industry — metals, nonmetals, fossil fuels — is valued at about \$3.8 billion annually, about 7 per cent of the Canadian Gross National Product. About 84 per cent of the metal mining industry is in copper, zinc, nickel, and iron. The exploration budget for this huge industry, however, has been dropping rapidly, from \$118 million in 1970 to \$71 million in 1972, and even further in 1973 and 1974, although figures aren't available yet.

Approximately 10 per cent of the exploration budget is expended in airborne geophysical work. Development of any new technology must be paid for out of this small amount, clearly not enough considering the need and, we hope, the impact, of new exploration technology.

The expenditure should be increased now. The Mining Association of Canada estimates that it costs about \$30 million for the discovery of one new mine, and at present expenditures, that means we are finding on the average two mines per year. After these mines are found, it takes about a decade to get them into production. And finding the mines is getting tougher and tougher because present and future exploration must concentrate on very remote spots — the easy sites have already been exploited.

By far the most important method of exploration for minerals to date has been using airborne magnetometers. Because deposits of many kinds of minerals create anomalies in the earth's magnetic field merely measuring

the fluctuations can give valuable clues as to where minerals are located, and just as importantly, rule out the large areas where they aren't. Since the advent of airborne magnetic surveys after World War II, Canada has been completely mapped magnetically. Although more information may be eventually gleaned from this method, the magnetic methods for mineral exploration must yield to more sophisticated methods.

In the middle 1950s airborne electromagnetic methods for exploration were developed, and most of Canada has now been explored in this manner.

To explain electromagnetic methods: When an electromagnetic field, produced by an alternating current, is induced in a coil or cable near the ground, corresponding electric currents are induced within nearby ore bodies which are conductors. By measuring these induced currents leaving the ground over wide areas, geophysicists can detect any areas containing highly conducting ore bodies, such as iron ores.

In airborne electromagnetic surveys, the high-powered transmitting coils and sensitive receivers are mounted on airplanes or helicopters, permitting wide-ranging surveys.

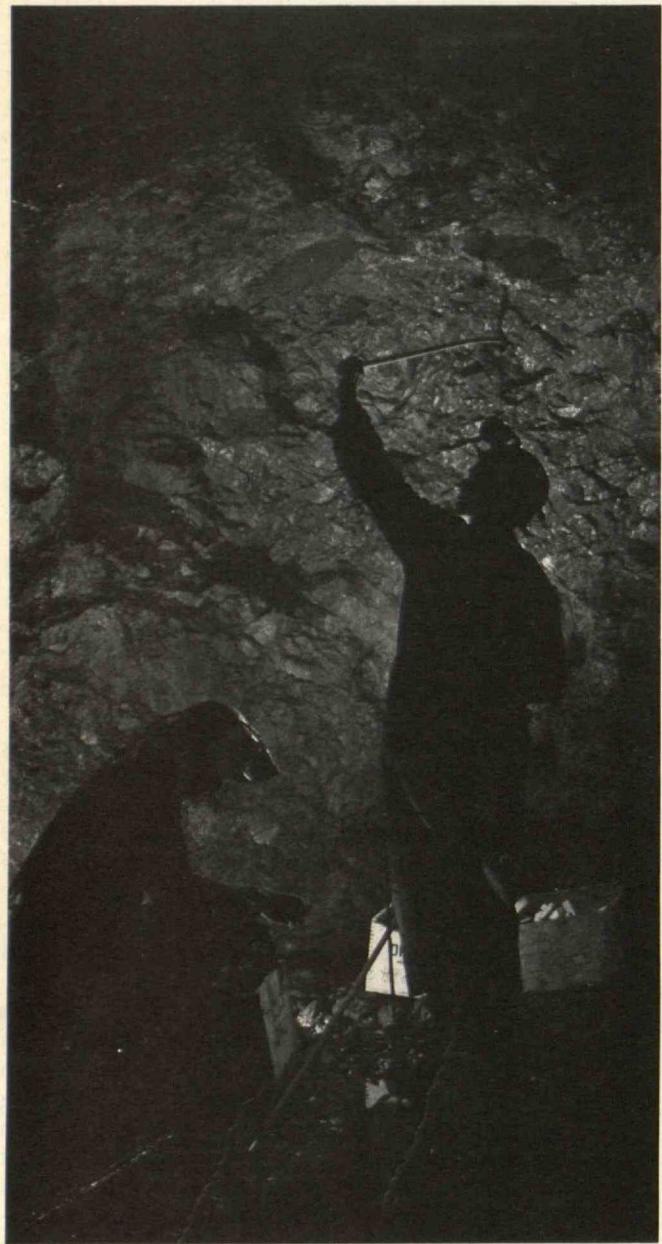
There have been a number of improvements in electromagnetic methods of exploration, although no major breakthroughs have been made in the last ten years or so.

Precisely calibrated transmitting and receiving systems have been introduced, allowing better data collection. For instance, electromagnetic surveying can be done at different frequencies to obtain the best results. Also the newer sensitive instruments allow measurement of the decay of induced currents with great precision. Such time-decay curves can give considerable information about the electrical nature of subsurface mineral deposits which hold an electric charge.

A major drawback to airborne electromagnetic surveys has been the rapid drop-off of the transmitting field with height — the field falls off as the cube of the distance from transmitter to ground. And the induced signal returning from the ground also drops off rapidly — anywhere from the inverse third to sixth power of the ground-to-detector distance. This drop-off is so large that even changes in an aircraft's height due to small hills and valleys can devastate readings. Additionally, even small movements of the coil and receiver relative to one another aboard the aircraft can give a false indication of an anomaly. Because of this effect, any new method for increasing transmitter power could prove a great boon.

At least one major company is investigating the use of superconducting transmitting coils to boost transmitting

New Techniques in Geophysical Exploration for Minerals



In a Saskatchewan uranium mine Canadian miners load a rock face with explosive to blast free uranium ore. Because it takes about a decade to get a mine into production after the deposit is discovered, we need a concentrated, sophisticated exploration effort now to assure future supplies. (Courtesy Information Canada Phototeque, by G. Hunter)

power. Such liquid-helium-cooled coils offer no resistance to electricity, and thus can generate enormous fields — 100 to 1000 times larger than present fields. One system now being developed utilizes the same coil for transmission and detection. Since the current flowing through a zero-resistance circuit is perfectly stable, any fluctuations would be due to received induced fields. Using the same coil for both functions would greatly reduce the possibility of variations due to changes in transmitter-coil spatial relationships.

Another promising development is the exploitation of the Josephson junction detector to detect induced magnetic fields. A Josephson junction is a thin insulator separating two superconducting materials. Electrons entering one superconductor "tunnel" through this insulator to set up an easily-detectable current. Such a superconducting detector is remarkably sensitive, for a very small signal can be amplified enormously and detected.

Increased transmitter power and receiver sensitivity will increase sensitivity, but just as important they will allow new kinds of data taking. For instance, sensitive Josephson junction detectors could be set up both at the front and in the rear of a surveying aircraft, and the differences in the two fields at a given point could be mapped extremely accurately, rather than measuring only the general ebb and flow of total induced fields. One hopes such new systems will be ready when we begin to do second-generation electromagnetic surveys of resource areas, so that we will not be merely going over the same ground with slightly updated instruments.

Another promising development in exploring for minerals involves taking advantage of the widespread network of VLF radio frequency transmitting stations maintained by the Navy. To carry submarine transmissions the Navy broadcasts a steady signal in the 15 to 20 KC range. Although the transmitting stations are sited around the world, the ones most useful to us operate from Seattle, Washington, Annapolis, Maryland, and Cutler, Maine.

Such steady, low-frequency signals are extremely useful for geophysical prospecting because like other low-frequency waves, the steady radio blanket they cast is disturbed by the resistivity differences from surrounding rock of many kinds of ores. Both ground and airborne systems have been developed that do quite well in detecting fields set up by these radio sources.

It is relatively easy to detect vein- or pod-type ore deposits because they set up fields which are readily distinguishable from background fields caused by surrounding materials.

World ore reserves

	Years
Copper	17
Lead	8
Zinc	18
Nickel	100
Iron	80
Aluminum	50
Gold	9
Silver	16
Mercury	10

But the massive stratiform deposits of ores, extending in horizontally-layered sheets across large expanses of an exploration area, are much more difficult to see.

The reason is simple. As an airborne survey crosses an edge of one of these deposits the instruments may react and then maintain that reaction until the other edge is reached. But these reactions may not be recognized by data analysts as deposits, but merely as "hiccupps" in the instruments.

One method of detecting these stratiform deposits is the magnetotelluric method, which consists basically of measuring the natural electric and magnetic fields emanating from the earth. The ratios of these two parameters can indicate the presence of mineral deposits because electric fields are more affected by mineral deposits than are magnetic fields, and thus the presence of a mineral deposit changes these ratios. And measurement of these parameters at different frequencies indicates the geological environment at different depths below the surface, because lower frequencies tend to penetrate from greater depths. The present frequency range of interest is 10 to 10,000 herz, which corresponds to depths of hundreds to thousands of meters.

Another approach to improving the detection of stratiform deposits is to improve the understanding of geological formations surrounding them.

In concert with other scientists at the University of Toronto, we have begun studies of the paleomagnetism of these formations to learn something of their origins. To explain: the magnetic north-south orientation of the earth has not always been as it is today. In fact, the earth has undergone a number of magnetic flip-flops over the eons, with the north pole swinging around to the south, and vice versa. But the magnetic orientation of a given rock is frozen into it when it is deposited, and that orientation corresponds to the magnetic north-south of the earth at that time. Our method was to collect rocks from formations surrounding stratiform sulfide deposits, and determine their paleomagnetic signatures. If we found that the surrounding rocks matched the ore deposits, we could infer that the formations and the ore deposits were formed about the same geologic time. On the other hand, if we got drastically different paleomagnetic signatures, this would imply that the surrounding formation and the ore body were formed at different times. So, in the former case, we would restrict our search to areas where everything had formed at once, and in the latter case we would search only areas where there had been some geological reactivation since initial formation.

Current reserves of a number of important minerals are in short supply, necessitating intensive probings of the earth's crust to locate new ore bodies. Because all the easy finds have already been made, more sophisticated methods will be needed to find the lower-grade, more inaccessible deposits we will soon depend on. (Source: U.S. Bureau of Mines, 1968 figures)

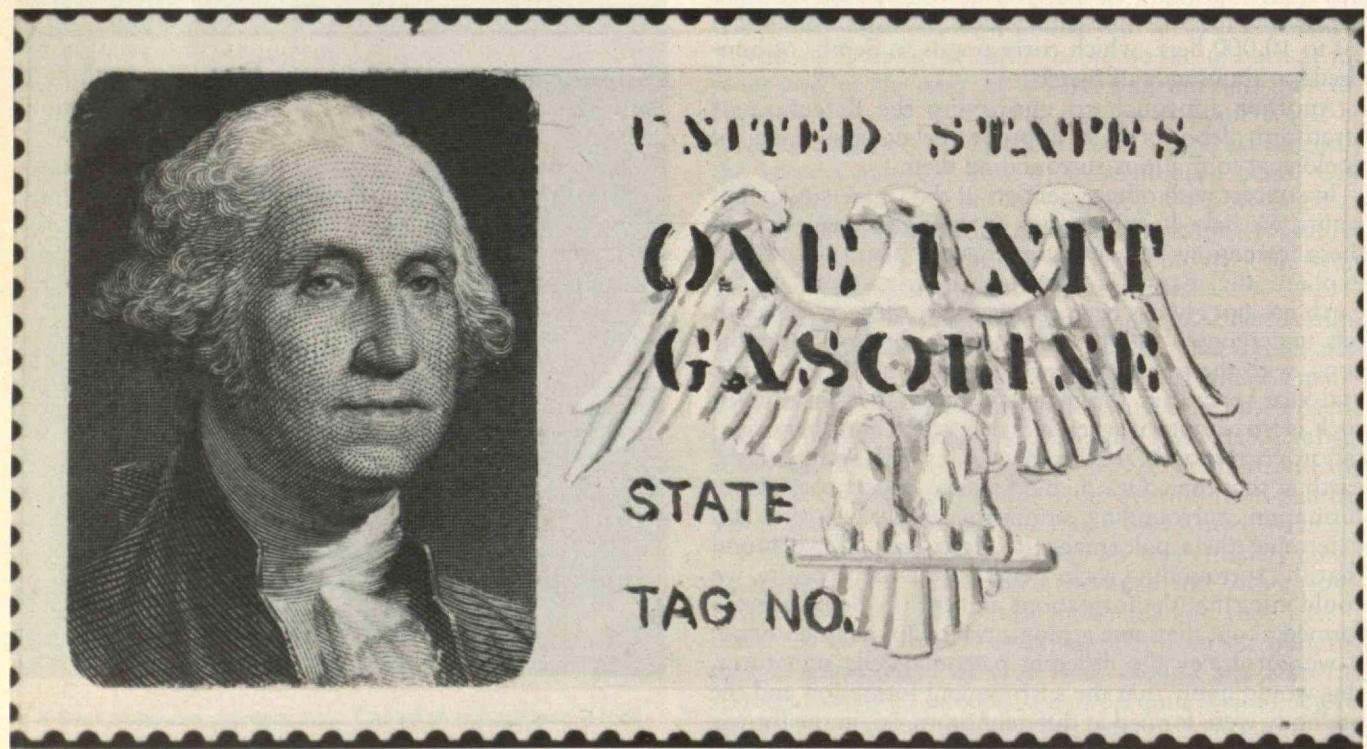
Of several areas examined, we got the best data from some deposits in Newfoundland and Missouri. Both the host and ore samples were magnetized in a direction quite different from the present-day magnetic field, which indicated that they had retained their paleomagnetic signatures. After careful analysis we found that the host samples and ore samples matched one another quite nicely, leading us to believe they were formed quite close together in time.

In view of all these developments in mineral exploration techniques and the short lifetime of our known mineral reserves, it seems obvious to me that we must learn how to detect minerals far better than we do now, and we must learn it quickly. We must develop new techniques to research at greater depths, and in more complicated terrains. We must be able to perform electrical measurements where electrical conductivities are extremely low, such as in deserts (due to sand's low conductivity) and Arctic permafrost (due to ice's low conductivity). We must improve our methods of digital data acquisition and automated interpretation. And we must concentrate on developing superconducting transmitters and receivers for electromagnetic mapping. Finally, there must be much more research on the physical properties of the various geological materials of interest.

We must make some rapid research and funding decisions so that we can have these new techniques available in the next five to ten years when we will need them to turn undiscovered mineral resources into discovered mineral reserves.

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Faced with the Crisis of 1974, the F.E.O. acted in the tradition of the established regulatory agencies. Its policies appear to have created the oil shortages.



Above: John Sawhill and William Simon in the Oval Office at the White House. Sawhill succeeded Simon as Administrator of the Federal Energy Office during that regulatory agency's brief

existence. Below: A mock-up of the rationing coupons that the F.E.O. only threatened to issue. The photographs were provided by the Federal Energy Administration.

The Federal Energy Office as Regulator of the Energy Crisis

Soon after the onset of the Arab oil embargo in the last quarter of 1973, the Federal Energy Office (F.E.O.) began operation in response to Congressional mandates to "deal with energy shortages, develop energy conservation, and promote efficiencies in the use of energy resources."¹ The F.E.O. managed the crisis, with subsequent effects on production, consumption, and inflation, until replaced by the Federal Energy Administration in June of 1974. The birth, middle age, and death of this regulatory organization all took place within less than a year and, given the general fear of energy shortages, each phase of the life cycle was extraordinarily hyperactive. Even under pressure, however, the F.E.O. behaved very much like the regulatory commissions in the energy industries — it did nothing very different from what was being done by state regulatory commissions or the Federal Power Commission.

The problem from October, 1973 to June, 1974 was to find the best set of policies for absorbing a two to three million barrel per day reduction in imports. The F.E.O. could have chosen measures to reduce the demands for imports — principally price-increase measures, since these are the most flexible and would use established markets. Or the Office could have let markets take import reductions in the form of shortages at controlled prices, and then could have rationed the shortages. The extent of the resulting price increases or shortages would have depended on the size of the embargo. In fact, the embargo's effect soon turned out to be different from the expected one. There were indications as early as November and December of 1973 that the Arabs' selective boycott against the U.S. was not working — "leakage" was allowing supplies meant for others to be diverted to the East Coast of the United States. Instead, the boycott was seen to be reducing total world production and raising world prices. The world price increases were extremely large — exceeding 50 per cent. This left the F.E.O. with either the price-increase policies, which would have enhanced U.S. supplies *at the higher world prices*, or policies to control prices and thereby reduce supplies from both domestic and foreign sources.

The F.E.O., as a matter of course, tried to do too many things on too many fronts. Spread thin over a number of emergency programs, their press releases and advertising on how to conserve, who should absorb how much "shortage," and so on actually had little effect.² Moreover, the daily exposure of the organization to the press and television added to the tendency to do more and more exhorting with less and less consequence. Still, the F.E.O. did devote much of its attention and resources to

three programs: price controls over domestic crude oil production and refined products; allocations of refinery runs among products so as to distribute the available refined to "most important users"; and an important and controversial program to allocate crude oil among refineries so that "crude-rich" refineries gave over supplies to "crude-poor" refineries. These three programs had effects in the early months of 1974; in fact, they produced the shortages that occurred during the embargo.

Price Controls and Domestic Crude Oil Production

The authority and apparatus for controlling energy prices were inherited in December, 1973 by the F.E.O. from the Cost of Living Council, under the Economic Stabilization Act of 1970. The inheritance was not impressive. After a succession of price and pay boards, regulations, and Phases I, II, and III, the energy sector of the economy had come under a two-tiered price system in August of 1973. This mechanism eventually established four separate categories of crude oil — old, new, released, and stripper crude. Only the first category³ was controlled at a ceiling price level equal to that in effect on May 15, 1973. The other three were allowed to seek the market-clearing price, because exploration for new oil required additional expense, or because stripper oil (production from wells unable to exceed ten barrels per day) was produced under conditions of high operating costs. The anomaly was released oil.⁴ For each barrel of new oil that a company produced, a barrel of its old oil would be released from controls. The rationale given for this category was that producers of old oil would be encouraged to develop new supplies since the increased price on "released" production would provide for more new production. The prices resulting in 1973 and 1974 are shown in the table on the next page.

In effect, the two-price system provided one-third of domestic crude oil supplies at \$10 per barrel, and two-thirds at \$5.25 per barrel, during most of the period in which the F.E.O. maintained controls. These inherited prices brought with them various distortions in crude production markets. Demands for old crude were exceptionally great, but they were not met by additional supplies because the controls made further expenditures on raising recovery in old fields less profitable than new development work in other fields. The excess demand became a way of life in the last quarter of 1973, as the F.E.O. took over and continued the previous pattern of controls.

This may have been the superior alternative. But price

Domestic crude oil production and prices in the first seven months of 1974. Roughly two-thirds of total production was "old oil"—supplies subject to price controls. The other third was divided among three categories freed from controls. This four-category, two-price system had been established to deal with domestic inflation; the Federal Energy Office continued its use throughout the Arab oil embargo. Source: the Federal Energy Administration's *Monthly Energy Review*, November, 1974.

	Uncontrolled						Controlled	
	Stripper wells		New oil		Released oil		Old oil	
	Percent	Price	Percent	Price	Percent	Price	Percent	Price
January	13	\$9.82	17	\$9.82	10	\$9.82	60	\$5.25
February	13	9.87	15	9.87	10	9.87	62	5.25
March	13	9.88	16	9.88	11	9.88	60	5.25
April	13	9.88	16	9.88	10	9.88	62	5.25
May	13	9.88	15	9.88	10	9.88	62	5.25
June	13	9.95	15	9.95	9	9.95	63	5.25
July	12	9.95	15	9.95	9	9.95	64	5.25

controls had been put in by the F.E.O.'s predecessors as part of general price and wage freezes, and they may not have been appropriate during a short-run reduction of supplies from the Middle East. There were efficiency effects: "old" crude came from deposits being depleted at an annual rate of five to fifteen per cent, with ultimate recovery of less than half of any inground reserve, and much could have been done to increase total recovery if there had been price incentives to do so. Controlling the prices of old crude had the effect of reducing secondary recovery, by an undetermined amount. The loss can be estimated from an equation in the M.I.T. econometric gas and oil model. Using the previous year's reserves as an estimate of the capacity in old fields, along with the controlled \$5.25 per barrel price, the simulated 1973 production is calculated to have been 0.33 million barrels per day less than if old oil prices had been the same as new oil prices of \$9.95 per barrel. And the simulated domestic crude production level in 1974 is 0.25 million barrels per day less than it would have been in the absence of "old" price controls.⁵ This reduction of domestic output is substantial. It follows from the price controls, and thus is a product of F.E.O. regulation.

Such a product is explainable. The F.E.O. may have forecast that little would be done by domestic producers to maintain the rate of production in the older producing formations. More to the political point, the F.E.O. may have believed that the additional production from old fields was going to be small compared to the size of the price increase on all old oil required to bring it forth. Equity toward lower-income consumers may have suggested that the country forego that additional output in order to keep prices down. This explanation may be sufficient, but even so it is curious, since it is predicated on the assumption that the additional supplies from older fields were less responsive to price changes than those from newer fields—otherwise, the same argument could have been used to set prices at five dollars for all production from domestic sources—and the assumption was not explicitly tested in the process of invoking the policy.

The most likely explanation for two-tier pricing is sheer inertia. The F.E.O. took over the rules of the Cost of Living Council and made them its own, perhaps without asking whether they were appropriate not for 1973 inflation, but rather for dealing domestically with the effects of sharp increases in import prices. Once the rules had become well-established, any argument that additional sources of supply in the short-run would be forthcoming had to be made by those seeking relief from the

rules. The burden of proof was difficult, took time, and the immediate effects on consumers of oil under relaxed controls would have been unpopular.

The most striking aspect of this regulation is its similarity to practices of the established commissions. The Federal Power Commission and the state electricity regulatory commissions both use "last period's price" as a guideline for determining current prices. The Federal Power Commission has indulged in this high art to the extent of holding "area rate hearings" in the middle 1960s to freeze the field price of natural gas at the actual level of the late 1950s,⁶ only to make upward adjustments in the late 1960s after the occurrence of excess demand.⁷ The state regulatory commissions in recent years have relied on changes in earlier periods' costs to justify changes in present price levels, and because current costs have exceeded historical costs, they thereby have managed to create circumstances in which actual rates of return on investment for power companies have fallen short of costs of capital.⁸ Throughout most of the history of commissions, the burden of proof has been on the companies seeking higher prices—they were required to show that additional supplies would not "cost the consumer too much more." The judgmental standards have been backward-looking and have had a tendency to downgrade production increases in favor of maintaining the status quo on prices.

Allocation of Crude Oil Among Refineries

Soon after its formation, the Federal Energy Office began to devise a mechanism to assure more crude oil supplies for refiners heavily dependent on Middle East oil. The F.E.O. also expressed concern for "independents"—small refiners that purchased their crude from major refining companies' own supplies. The mechanism chosen was a mandatory inter-refinery allocation program which required "crude-rich" refiners to share their stocks with "crude-poor" refiners. This was put into effect in its initial form on February 1, 1974, but was revised a number of times during the lifetime of the organization. Still, the substance of the program remained its requirement that refiners with above-average crude supplies sell to crude-poor refiners until each refinery could operate at the same average percentage of capacity. The price charged on the resale was to be set equal to the weighted average of the crude-rich refiners' costs for oil from all sources, domestic and imported.

This price averaging should have had an immediate damping effect on imports. Any company that imported

<i>Monthly average imports per district (millions of barrels)</i>	<i>Crude oil inventories at beginning of period (percentage of previous period)</i>
September, 1973 to October, 1973	27.1
November, 1973 to December, 1973	23.7
January, 1974 to March, 1974	17.4
April, 1974 to June, 1974	27.8
	101

Crude oil imports in 1973 and 1974. The Arab oil embargo began in the last quarter of 1973, but imports during the last two months of that year were down only slightly. A more substantial drop occurred in the first quarter of 1974 — the months during which oil refiners who succeeded in importing large quantities were compelled to sell some of it to less fortunate refiners. This reallocation program was modified in the second quarter, and imports rose. Source: Bureau of Mines, *Mineral Industry Surveys*. The import figures are averaged over P.A.D. Districts I, II, III, and V; the "previous period" is the preceding period of the same length.

crude to utilize a high percentage of its refining capacity would have to pay \$10.00 per barrel for the imports and then deliver them to other refineries for compensation of slightly more than \$7.00 per barrel. Those refineries previously unable to obtain enough imports to run at the industry average of 76 per cent of capacity would no longer worry; rather than buying abroad at \$10.00, they could wait for other domestic refiners to deliver to them at the \$7.00 price. Both actual and potential importers had strong incentives against importation around and through the embargo.

By mid-February, 1974, the F.E.O. was already receiving negative feedback on the allocation program from the crude-rich refiners. F.E.O. Administrator William Simon conceded that the program would probably lower imports to the East Coast, especially from Venezuela. Deputy Administrator John Sawhill was already considering amendments to the plan, particularly that of restricting deliveries from the crude-rich refiners; perhaps they would go only to "smaller" crude-poor refiners. The Gulf Oil Corporation filed a suit against the F.E.O. charging that the order to sell 11.9 million barrels to other refiners was confiscatory; most of the crude-rich refiners complained of a resale "price squeeze," even though they supplied 56 million barrels to crude-poor refiners during the period from February to April.

There were ways of evading the rules, however. The vague wording in successive revisions of the original order allowed manifold interpretations of what the resale price should be. One revision allowed "an additional cost" of 84¢ per barrel on every barrel transferred from one refiner to another. A second allowed prices to increase to "reflect crude oil costs prior to making crude oil sales." The word "costs" could be interpreted in a way that allowed sellers to recover completely the original purchase price on the marginal supplies from abroad. Later in the year, Sawhill — now the F.E.O.'s Administrator — complained that those taking advantage of both adjustments were "double dipping" so as to obtain a profit margin of 84¢ per barrel on the \$9.87 marginal price of foreign crude oil, and that this had cost the consumers millions of dollars in overcharges. Most companies denied that they had dipped twice, but the possibility exists that there were loopholes in the regulations that allowed the evasion of the restrictive rules.⁹

In fact, however, there generally were restrictive effects: Simon predicted in February, 1974 that there would be a decrease in crude imports, and as shown in the table on this page, there were reductions of imports,

but only in the months of the allocation program. By working around the Persian Gulf States' controls, importers had managed to obtain 87 per cent of previous months' volumes in November and December. Of course, some part of the sustained volume came from having inventories still on the high seas, shipped before the embargo was imposed; but a good part of it also came from "working around" the boycott of shipments to the United States. By January, when the refinery allocation program was known to be imminent, imports fell somewhat, and in February and March, when the program was in full effect, imports fell considerably more. In these first three months of 1974, monthly average imports per Petroleum Administration District fell to 73 per cent of volumes during the preceding two months in the same Districts. This does not reflect the "working off" of excess crude inventories, as the right-hand column of the table shows.

At that point, the situation changed. Deputy Administrator Sawhill had been talking about altering the program for some time; revised rules were widely circulated during April and put into effect in May. They indicated that the receivers in any allocation program were going to be only the smaller refiners, so it was expected that not too much oil would be reallocated in the next few months. (Also, a revision in the program had been made in March that allowed imports over "projected levels" to be excluded from reallocation.) During the period from April to June of 1974, there was considerable increase in the amount of imports; the average amount imported per month per district was up 59.7 per cent over the amount in the January to March period.

Administrator Simon had predicted that it might cost the economy 1 million barrels of imports per day to impose the allocation regulations. If the entire difference between 17.4 and 27.8 million barrels per district is attributed to the allocation program, the Simon total was reached in the January-March months of the program.¹⁰ The F.E.O. had made a choice between a policy "equitable" for large and small refiners and one that added to supplies in domestic markets. Rather than giving over crude to "crude-poor" refiners, the F.E.O. could have allowed them to fend for themselves as the reductions in Middle-East production took effect. Those with established channels of distribution and the ability to evade embargoes would have worked their way around the reductions and obtained more of the supplies for the United States. The results, although "unfair" because of reduced market shares for smaller refiners, would not have included a significant reduction in imports early in 1974.¹¹

Price Controls and Petroleum Products Shortages

The Federal Energy Office was set up within a context of crisis, to see that consumers got the right amounts of heating oil, diesel fuel, and gasoline. A number of alternative schemes to distribute refined products had been proposed within the Government late in 1973, ranging from full-scale World-War-II type rationing to the exclusive use of price increases to clear excess demands. The F.E.O. chose a mixed program, including consumption controls, the depletion of domestic inventories, and, last of all, rationing.

"Take-it-as-it-comes" was the program's philosophy; the F.E.O. would see whether the embargo deprived the United States of the 2.8 million barrels per day being imported from Middle Eastern countries. If the embargo had been fully effective, then the early parts of the program would have been insufficient: "mandatory conservation" by reducing speed limits and Sunday gasoline sales would have cut consumption by only 0.4 million barrels per day, according to the F.E.O.'s own estimate; and there would not have been enough stocks to cover embargoed inflows if the embargo lasted over six months. Thus the F.E.O., in fear of outage, required refiners to produce a particular mix of products and distribute them in allotments to wholesalers and retailers. At the same time, rationing was postponed, but a proposed scheme was used as a prod — during the embargo's first six months, plans for ration-ticket distribution and an enforcement organization would be put into place, and continued publicity for the building of these institutions would serve as a message to consumers that they had better reduce demands.

Early in 1974, the F.E.O. put the first round of refinery allocation rules into effect by requiring cutbacks in the production of gasoline and expansion in the production of fuel oil. This was to provide more fuel oil for the winter, postponing and converting any overall shortage to a gasoline shortage in the spring and summer. The rulings were justified by health and safety reasons, and on grounds that the demands for fuel oil were less easily reduced than those for gasoline.

The size of the mandated changeovers to fuel oil were based on forecasts of supplies, demands, and imports in November and December. With a fully effective embargo, imports were expected to decrease from 6.8 million barrels per day to slightly more than 4 million barrels per day, according to Department of Interior transmittals to the Energy Emergency Action Group carrying out the policy analysis for the new Federal Energy Office in

November. This reduction could be parcelled out at prevailing prices by refinery regulation so as to eliminate a 10 per cent production shortage in heating fuel and create a production shortage of approximately 25 per cent in gasoline for the first quarter. (Given substantial gasoline stocks on hand, the actual gasoline shortage could be postponed until later in the year, when the embargo might be over, or at least less severe.)

But there were alternative forecasts. Of the half-dozen most prominent ones available in October and November, no two agreed on the size of the embargo, on total United States demand, or on how much would be available from domestic sources. This was understandable, since predictions would depend upon policies to be invoked by the F.E.O. — on the level of domestic prices, on incentives for domestic refiners to evade embargo restrictions, and on the allowed use of inventories. The October forecasts, based on various policy assumptions, showed a range in the supply-demand gap of as much as 1.3 million barrels per day.

As time passed, the forecasts converged and grew lower. By the middle of December, it had become known to F.E.O. analysts that the October estimates predicted too much shortage. An Office of Management and Budget (O.M.B.) analysis showed that "a slower economy, price increases, and existing (first-round) conservation programs reduce the first quarter of 1974 shortage to 1.8 million barrels per day." Furthermore, the O.M.B. proposed that domestic production be raised above state-controlled levels and also proposed the reduction of secondary inventories — those in the hands of industrial and household consumers — so that the shortage would be reduced to less than a million barrels per day. The Conference Board showed at the same time that the forecast first-quarter 1974 shortage would be 1 million barrels per day less than that given in the President's Energy Message of November, 1973, or slightly more than 2 million barrels per day. Finally, the Department of the Interior's Petroleum Situation Report, available to F.E.O. staff members on a weekly basis, indicated early in December that imports "had failed to decline as much as was forecast, and demand has been reduced below that forecast. Each of these factors accounts for approximately half of the forecast deficit" — that is, half of the difference between what the Department of the Interior had predicted — 2.8 million barrels per day — and what it was predicting now — 1.4 million barrels per day for the first few months of 1974. Thus the forecasts seemed to center on shortages of 1.5 million barrels per day (with



a range of 0.5 million) rather than 2.8 million (with a range of 1.3 million) as forecast in October.

These later predictions implied a different set of policies than those invoked by the F.E.O. To be sure, the first-round measures to save on gasoline might have been advocated anyway. But if the supply-demand gap was going to be 1.5 million barrels per day, rather than twice as much, it should have been possible to clear it with only moderate price increases on gasoline and fuel oil. With the addition of some optimism on when the embargo would be over, stocks could have been run down without any increase in prices, and the policy proposal would have been pure *laissez-faire*.

The F.E.O. in fact chose policies based on pessimistic forecasts. In January of 1974, the Office of Energy Analysis of the F.E.O. produced reports forecasting the domestic supply-demand gap under a specific set of pre-conditions in international crude markets. Assuming that there would be no domestic production increase in the short run, and no substantial price effects on demands, the report indicated that stocks could be drawn upon so that the gap did not exceed 2 million barrels per day in the first quarter, or 2.5 million barrels per day in the second. But by the fourth quarter of 1974, assuming the continuation of a full "working" embargo, there would be excess demands of 2.8 million barrels per day, with

products inventories at such low levels that no more could be withdrawn. The "temporary expedient" of reducing inventories "delays the major impact of shortages," the Office of Energy Analysis wrote, "but the lack of these inventories will compound the problems appearing in the subsequent winter (fourth quarter 1974) if the embargo is not lifted." On the basis of an assumed winter of 1974-75 embargo, the allotting of crude to fuel oil production at the expense of gasoline was put into full effect in January of 1974.

Early in the new year, motorists in many of the more populated parts of the country began to experience significant queues at gasoline stations. These lines were a manifestation of the crude allocation program because the operation of the program led to reductions in refinery output of gasoline and forced holdings of inventories, which together reduced deliveries to retailers. With controlled prices, the retailers sold the reduced amounts of gasoline on a "first-come, first-served" basis — if not on the basis of friendship, physical violence, or side payments. By allotting reductions in crude supplies to domestic gasoline retailers, rather than drawing upon inventories or raising prices, shortages were chosen as the means to impress the populace with the energy crisis.

These policies of the F.E.O. are justifiable in some ways but not in others. The rationale for taking a "pessimistic"

view was to reduce the chance of catastrophic outage if the import curtailment were worse than expected. If the Office had been compelled to embrace pessimistic estimates, then the choice of a forecast supply-demand gap greater than 2.0 to 2.5 million barrels per day was justified. These numbers dictated that crude supplies be reallocated to fuel oil production and that the available inventories be held for the summer peak in automobile use. But by other standards, the F.E.O. policies are not justifiable. Any policy designed to alleviate a potential supply-demand gap should have been flexible enough to deal with the occurrence of either *no* excess demand or *severe* excess demand. But the F.E.O. scheme, like those of most independent regulatory commissions, was designed to be inaugurated under conditions of certainty and to remain unchanged for significant periods of time — refineries were to produce more fuel oil, and inventories were to be held off the market for the winter of 1974, no matter what actually happened to imports and domestic crude production.

More flexible schemes were available; most would have relied more on market pricing mechanisms than did the refinery output allotment schemes. The most likely of these alternative policies would have simply allowed prices on gasoline to increase.¹² In the extreme, this program could have become quite inequitable to the lower and lower-middle income classes, but if so, the hardships could have been eliminated by issuing coupons on a *pro-rata* basis, with the total number of coupons equal to the predicted supply of gasoline. Drivers could have sold the coupons if they preferred the money to driving, or could have purchased gasoline with a coupon at, say, a 50¢ price, given that the coupons drove down the demands to equal total supplies at that price. The production and distribution of coupons could have been an F.E.O. program — the F.E.O. was already making threats to institute rationing, so the coupons were printed and could have been distributed with little expense and delay. The F.E.O. thus had a clear choice between a flexible, price-oriented program and the allocation program that they actually used in the first half of 1974.

They chose the more "regulation-oriented" of the immediate alternatives. The choice was cautious, in that it minimized the probability of complete outage of heating oil during the winter, and gasoline the following summer, under an extreme and well-functioning embargo throughout 1974. The choice used existing institutions, and procedures common to the regulatory organizations of the Federal Government. It did not follow from the information *becoming* available at the time and, in particular, was not revised in the light of more current information showing that both the embargo and the winter weather were not all that serious in December and January. It probably produced the lines at gasoline stations all by itself.

Repeating Regulatory History

The Federal Energy Office was different in form from most of the energy regulatory commissions, but perhaps it was not entirely different when measured in terms of results. The F.E.O. made rules that depended on extrapolating regulatory conditions in existence before the Arab embargo. It thus failed to create incentives that could have brought about expanded supplies under conditions unique to the embargo. These incentives, in higher prices and profits, would probably have brought forth

more domestic production of oil from older formations, more imports from abroad in the first quarter of 1974, and more gasoline in the final product mix during January to March of 1974. The three together would have eliminated lines at gasoline stations, or any other manifestation of an embargo imposed on the American consumer.

How do the regulatory effects add up? During the first quarter of 1974, the controls on old oil prices probably reduced supplies from domestic sources by 0.25 to 0.33 million barrels per day, and the inter-refinery crude allocation scheme probably reduced imports by up to one million barrels per day. Shifting refinery outputs toward heating oil and away from gasoline was expected to reduce supply of gasoline by 0.8 million barrels; because of regulation-induced reductions in overall runs, the gasoline reduction may in fact have been somewhat greater. Given the forecasts that the supply-demand gap under the embargo was going to be less than two million barrels per day (even assuming no policies other than speed-limit and airline flight controls), these actions before the fact added substantially to the gap. After the fact, the gap turned out to be resolved by demand reductions due to the down-turn of the economy, warm weather, additional supplies around the embargo, and queues for gasoline (the "real" shortage was perhaps 0.3 million barrels per day). The queues could have been avoided by not having put either refinery program in effect. We give the F.E.O. credit for having created the "energy crisis" perceived by consumers.

The credit might have been worth having under some conditions — particularly conditions which in fact did not occur, but had a small *a priori* probability of occurring. The embargo might have been more prolonged and more effective. If this had been the case, then prices on domestic markets would probably have increased another 20 to 30 per cent, with significant adverse consequences for low-income energy consumers. There might have been strong and adverse effects upon industrial production of chemicals, primary metals, glass, and food products, where energy utilization is relatively great. Under these extreme conditions, use of market mechanisms alone would have meant political default for the Federal Energy Office — they would likely have been run out of existence by Congress. But this could have been prevented by supplementing flexible pricing with coupon issues or other programs that restored equity to low-income consumers. Coupon schemes were among the options considered by the F.E.O., but they were abandoned; the F.E.O. preferred direct controls on production to flexible pricing.

It is in this behavior that the F.E.O. turned out to be similar to the other energy regulatory commissions. Theories of bureaucratic action¹³ point to general patterns of response which the F.E.O. clearly followed. On being presented with critical choices, bureaucracies will adopt a set of tightly constrained goals, invoke standard operating procedures, and generally act so as to avoid default at all costs. This last strategy is dictated by a reluctance to evaluate the entire probability distribution of future events. Rather, the most obvious, "worst" event is seized upon as a horror to be avoided. Once the horror is decided upon, programs are created which organize and focus the actions of the agency. The process automatically incorporates a high degree of inflexibility so that only small incremental changes are possible at any time.

This approach spelled trouble for the F.E.O., particu-

larly in dealing with prices. At some point, most energy regulatory organizations have had to determine whether prices should increase. They habitually resist a change from last period's prices unless proof that supplies will increase is given by the producing companies themselves. This process does not work when cost or supply conditions change rapidly and significantly, nor when the current costs are above the historical level of prices. Then regulatory organizations create shortages by force of habit. The F.E.O. fell into this pattern and repeated history.

Footnotes

¹ U.S. Senate, *Hearings Before the Subcommittee of Government Operations* (December, 1973).

² The National Petroleum Council has estimated that the F.E.O.'s conservation programs reduced demands by close to 0.7 million barrels per day, in *Emergency Preparedness for Interruption of Petroleum Imports* (September, 1974). These are the roughest of estimates, obtained by multiplying driving speed by fuel usage, and cannot be used for policy analysis.

³ "This is domestically produced crude petroleum that is subject to the ceiling price for crude oil. For a particular property which is not a stripper-well lease, the volume of controlled oil equals the base production control level minus an amount of released oil equal to the new oil production from that property." *Monthly Energy Review*, F.E.A., November, 1974, p. 42.

⁴ "Released oil is that portion of the base production control level for a property which is equal to the volume of new oil produced in that month and which may be sold above the ceiling price. The amount of released oil may not exceed the base production control level for that property." *Monthly Energy Review*, F.E.A., November, 1974, p. 45.

⁵ The econometric model is described in detail in Paul W. MacAvoy and Robert S. Pindyck, *The Economics of the Natural Gas Shortage (1960-1980)* (Amsterdam: North-Holland, 1975). A large-scale model, it focuses both on the political-technical institutions and on economic analysis of the performance of the natural gas industry. Separate equations are estimated by use of generalized least squares (GLS) for (1) exploration and discovery of oil and gas, (2) production of gas out of reserves, (3) pipeline markups and (4) wholesale demands. While not explicitly dealt with in the M.I.T. model, an oil production equation has recently been estimated with the following results, (t-statistics are in parentheses):

$$USQO_t = 14,432.40 + 9461.71(USPO_t) + .08(RSVS_{t-1})$$

(2.17) (1.75) (27.32)

$$R^2 = .87 \quad N = 160 \quad F = 534.49$$

where

USQO_t = quantity of oil produced over twenty U.S. production regions in period t.

USPO_t = average U.S. wellhead price of oil in period t.

RSVS_{t-1} = total reserves of oil in the previous period.

The above coefficients along with the GLS ρ values for twenty production districts were used to simulate the amount of production that would be forthcoming under regulated and unregulated price policies. The resulting estimate of 0.25 to 0.33 million barrels per day may be high; the *Oil and Gas Journal*, an industry publication, indicated early in February, 1975 that the maximum available from secondary recovery on old fields would be 0.2 million barrels per day.

⁶ See Stephen G. Breyer and Paul W. MacAvoy, *Energy Regulation by the Federal Power Commission* (The Brookings Institution, 1974); Keith C. Brown, *Regulation in the Natural Gas Producing Industry* (Resources for the Future: Johns-Hopkins University Press, 1972); Edmund W. Kitch, "The Permian Basin Area Rate

Cases and the Regulatory Determination of Price," *University of Pennsylvania Law Review*, Vol. III, 191, 206-13 (1967); Edmund W. Kitch, "Regulation of the Field Market for Natural Gas by the Federal Power Commission," *Journal of Law and Economics* (October, 1968).

⁷ Paul W. MacAvoy and Robert S. Pindyck, *op. cit.*

⁸ Paul L. Joskow and Paul W. MacAvoy, "Regulation and the Financial Condition of the Electric Power Companies in the 1970's," *American Economic Association Proceedings*, to be published in June.

⁹ Estimates of the amount of double-dipping which actually occurred have ranged from \$300 million to \$2 billion. See *Boston Globe*, October 14, 1974 and U.S. General Accounting Office, "Problems in the Federal Energy Administration's Compliance and Enforcement Effort," December 6, 1974.

¹⁰ It might be objected that the inter-refinery allocation program was not the only cause for curtailment of imports — the embargo itself began to work at that time. But given a four to six week lag from curtailment in the Persian Gulf to reduced imports in the United States, this would imply that the embargo took effect in the Middle East in December, which is two months after the embargo's announced beginning. Moreover, there were no obvious changes of O.P.E.C. policies or controls in December.

¹¹ Not only were imports reduced during the January-April period, but crude runs in refineries were reduced as well. Crude runs depend upon inventories, as a matter of course. Taking crude runs as a percentage of inventories (both seasonally adjusted), the estimates for November, December, and January are 1.54, 1.50, and 1.50 respectively. The estimates for February, March, and April are 1.40, 1.45, and 1.50. Thus crude runs as a percentage of inventories were down 4.2 per cent during the inter-refinery allocation program — another indication of the effects of this program.

¹² What would the market-clearing gasoline price have been in February? Robert Hall of M.I.T. has estimated that the average value of the time spent waiting in line at a gas station is \$1.50 for an average 45-minute wait (as derived from transportation studies of the average value of time spent driving a car to and from work). If the deregulated gasoline price had been 10¢ per gallon higher than the controlled price, then a customer would have paid that \$1.50 as an extra cost for a 15-gallon fillup — provided there were no lines at the pumps. This therefore would have been the equilibrium price.

In many areas, purchases were limited to \$3.00, or only six gallons of gas. Assuming a 30-minute wait at these pumps, with the same \$2.00 per hour value of waiting time, the additional cost for the deregulated gasoline would be \$1.00 for six gallons, or 17¢ per gallon.

¹³ R. M. Cyert and J. G. March, *A Behavioral Theory of the Firm*, Englewood Cliffs, N.J., 1963, and G. T. Allison, *Essence of Decision*, Little, Brown and Co., Boston, 1971, pp. 78-96.

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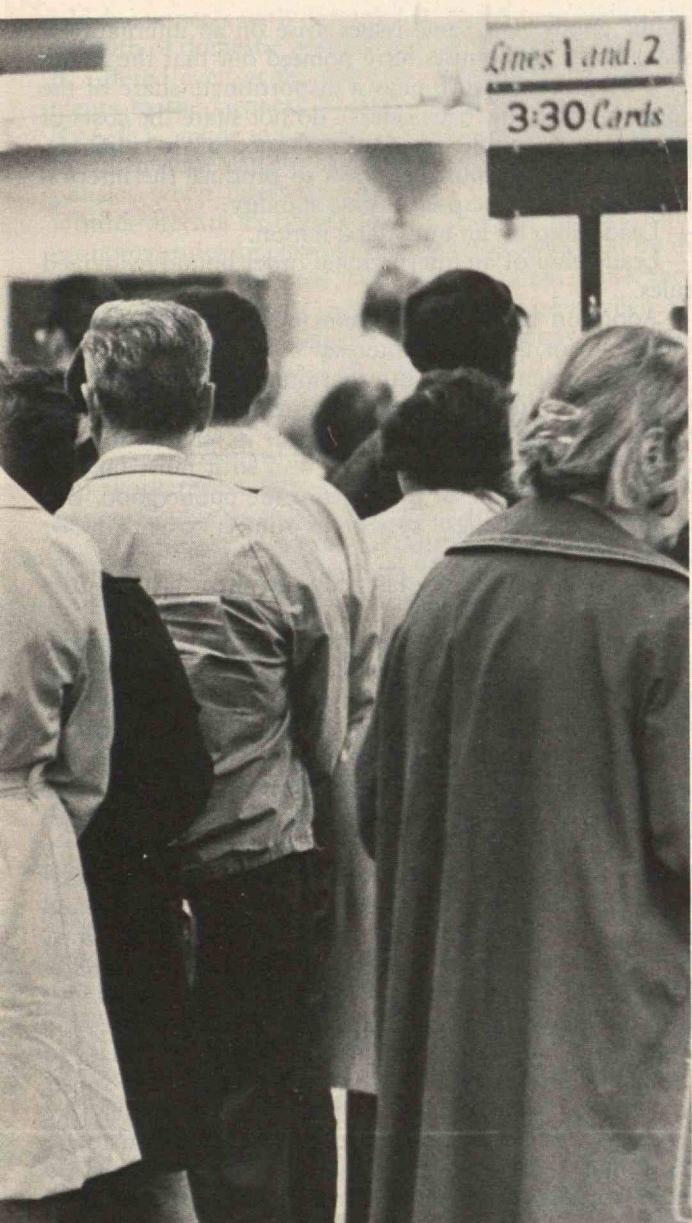
Lessons from 1929 for the Petro-Dollar Problems

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"Each country wants . . . to combat depression on its own. Moreover, each country has a government which is responsible for the 'public interest' – the provision of the public good by maintaining income and avoiding inflation."

International economic stability depends upon a leader who sees the long-range convergence of private and public interest. Today's petro-dollar problem is rendered more serious by the uncertainty of such leadership toward the cosmopolitan welfare.



Most discussion of business cycles and of macro-economic policy today is in terms of a closed economy — describing a single country without external connections. Each country wants balance-of-payments equilibrium to achieve autonomy in order to combat depression on its own. Each country, moreover, has a government which is responsible for the "public interest," i.e. the provision of the public good by maintaining income and avoiding inflation. Within the overall stability provided by government, households and firms maximize their profits, or utility, or welfare. If there were no government, it is not clear that overall stability would be preserved.

Adam Smith believed that men were never so innocently engaged as when trying to make profits, but since his day we have discovered the fallacy of composition — that sometimes the whole is less or more than the sum of its parts. If each firm or household maximizes its profit or welfare at the expense of others, each seeking to improve its position, the entire set of households or firms suffers. The common illustration is that while households and firms may be better off with more savings, for everyone to save makes the depression worse rather than better.

If we move from the national closed to the world open economy, we must leave government behind. There is no world government to provide the international public good of macro-economic stability. If each country tries to improve its position by "beggar-thy-neighbor" devices — by imposing a tariff, depreciating an exchange rate, subsidizing exports — there is likely to be retaliation, and all nations end up the poorer as a result of each trying to better itself. Recovery measures which are not subversive of the common good have costs: to expand government spending in an open economy, for example, leads to balance-of-payments difficulties as increased income stimulates imports. We need the public good of international macro-economic stability, and there is virtually no way to provide it.

The principle of the "free rider" — the view that says pass the buck, let George do it; I am too small and weak to undertake the provision of public goods whose benefits accrue to others as well as to me; let others take on that responsibility — leads to underproduction of public and overproduction of private goods. Note that this differs drastically from Kenneth Galbraith's view that private goods are overproduced because of advertising and irrationality. Our principle asserts that producers and consumers are rational, but that it is not sensible for a consumer to undertake a disproportionate share of the cost relative to his benefits, such as appears to be involved in

Petro-Dollar



"The 1929 depression was so prolonged, so widespread, and so deep because the world was in transition from leadership by the United Kingdom to leadership by the United States. Such transitions are fraught with uncertainty, and on that account dangerous."

public goods. The same issues arise on an international scale: some economists have pointed out that the leader of a defensive alliance pays a disproportionate share of the costs, because the "free riders" do not share the costs of producing the public international good of the alliance.

There are four possible ways to produce the international good of macro-economic stability:

- Leadership by an individual nation.
- Leadership of an international order bound by agreed rules.
- Adoption by all of a system in which each country looks out for the public interest.
- Achievement of an international understanding in which each country, while conscious of its short-run interest, is aware that in the long run its private interest accords with the public interest and so it must take its proportionate share of the costs of the public good. Unhappily, each of these systems is subject to entropy or decay.

Let us dispose of the last three of these ways before going back to leadership.

Each country is likely to be aware of its long-run public interest in international macro-economic stability, but most countries may regard themselves as too small and too weak to affect that stability. Thus they may just as well look after the short-run national interest. But the small countries, acting simultaneously and driven by the same stimuli, add up to a large country and are no longer weak. This is how the Belgians, Dutch, and Swiss drove Britain off the gold standard in September, 1931, each believing itself able to get away with it, when the United States and France could and would not. In a similar way, Belgian conversions of dollars to gold applied the *coup de grâce* to the United States' ability to convert dollars into gold in August, 1971. It is ironic that in these cases the "powerless" countries turned out to have done damage to the public international interest in pursuing their short-run national concerns. In normal times when they act separately, this is unlikely to be the case. While there are those that deplore the rats deserting the sinking ship, a more sophisticated and understanding observer asks what is the preferred course of action for the rats.

Rules of international conduct are, of course, the hope of limiting national action which would threaten international stability. But there are times when individual countries feel that they cannot afford to adhere to self-denying ordinances: pressure on their balance of payments may be so strong that they cannot avoid restrictions on imports or exchange depreciation; unemployment in an industry

which competes with imported products may evoke such strength of domestic political unrest that protection must be offered even at the expense of maintaining commitments to the General Agreement on Tariffs and Trade (G.A.T.T., made in Geneva in 1947); or domestic unemployment may call for expansionary monetary and fiscal policies when international rules of the gold standard would dictate contraction. In the closed national economy, rules against wrongdoing are supported by the police power of the state. In the international arena, there is no world state with police power, and even where the rules of the game envisage sanctions, they may be difficult to enforce. The League of Nations called for sanctions against Italy when it invaded Ethiopia in 1935, and the United Nations called for sanctions against Rhodesia over its treatment of blacks and Indians. But sanctions do not work unless they are universally enforced, and experience suggests that they seldom are.

Agreement to proscribe "beggar-thy-neighbor" conduct in trade policy has been reached in G.A.T.T. and thus far effectively adhered to, and exchange depreciation under the system of floating which replaced Bretton Woods (the 1944 agreement which established the International Monetary Fund and the World Bank) has been constrained. But without a central governmental body with sanctioning powers the system is fragile. Self-denying rules can be broken and will be broken if the stakes are high enough — if the tension between the private national and the public international interest mounts high.

Having disposed of these alternatives, we are left with the system of leadership under which one country acts consciously in the cosmopolitan welfare, becomes responsible for that welfare, exerts pressure on the other countries in the system to adhere to that general welfare, and takes over such burdens of stability that other free-riding powers refuse to carry. *Pax Romana* lasted for centuries, *Pax Britannica* from 1815 to 1914, and *Pax Americana* has been in effect since 1945. In the economic field, the gold standard prior to 1914 was effectively the pound sterling standard, with Britain acting in monetary matters in the international interest, which it identified with its own. The Bretton Woods, G.A.T.T., F.A.O. (the Food and Agriculture Organization of the U.N.), and other international agreement systems in effect since 1945 were in fact United States systems — a dollar standard. A staff member of the International Monetary Fund once said privately that when the United States proposed nothing, nothing happened.

Leadership by a hegemonic power breaks down, just as do systems of rules, self-denial and altruism, but for somewhat different reasons. The burden on the leader of the system allows room for other powers to make economic advances. The world apart from the leader regards the system as exploitative, and views the identification of the cosmopolitan interest with the long-run interest of the leader as dissembling. On the other side, the leader thinks of itself as bearing an undue burden of the system. Perceived by both the leader and the led as exploitive of itself by the other, the system winds down. In time a new leader and a new system emerge, but the times of transition are extremely uncertain.

The theory of the business cycle embraced here is that a stable system must have a stabilizer. Even with a stabilizer there will be business cycles, from which recovery will be brought about in relatively short order either by built-in automatic forces or by anti-cyclical policies. The 1929 depression was so prolonged, so widespread and so deep because the world was in transition from leadership by the United Kingdom to leadership by the United States. Such transitions are fraught with uncertainty, and on that account dangerous. But in the period from 1929 to 1933, and especially in 1931, the British could not lead, and the United States would not. Responsibility for providing the public cosmopolitan good of world stability had been cast aside by the British but not picked up by the United States.

Brother, Can You Spare a Dime?

The reader should be warned that this is not a generally accepted theory. Theories range from the mono-causal, which hold, for example, that an ordinary downturn in 1929 was transformed into a major world depression by mistakes of monetary policy on the part of the United States, to, at the other extreme, the view that the depression of 1929 was the result of a series of historical accidents. Between is an infinitude of variations emphasizing a variety of factors: the chaotic state of world finances after the breakdown of war debts, reparations and the attempt to restore pre-war exchange rates; the deflationary policies of Hoover in the United States, Snowden in Britain, Bruening in Germany, and Laval in France. There is a school which emphasizes overproduction after World War I, especially in agricultural products when European losses were made up without a corresponding cutback in the new acreage which had come into cultivation during and immediately after the war; another calls attention to the housing boom, including

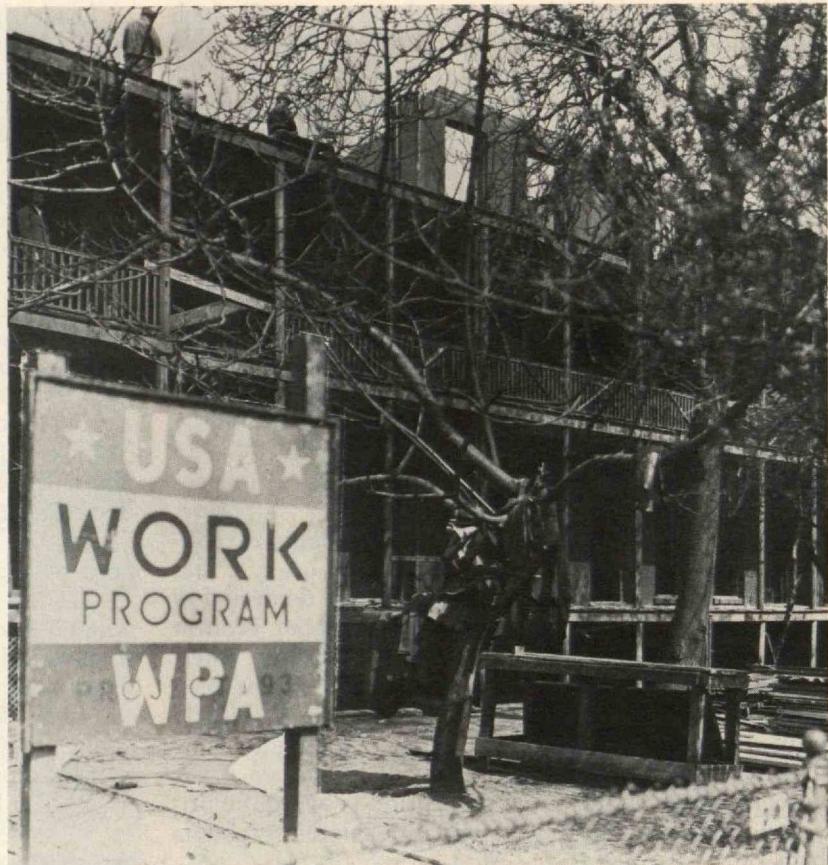
"Roosevelt . . . turned inward and away from international programs, relying on a bewildering variety of devices — NRA, work relief, exchange depreciation, printing silver certificates, crop restrictions and the like — in the hope that one or more of them would help more than the others hurt."

the Florida speculative land boom which sagged after 1925. Some blame, some exonerate the stock market. Europeans claim that the eye of the storm could be found in the United States; Americans — particularly President Hoover — found that the difficulties originated in the short-sighted but self-serving policies of the European countries. Especially emphasized in the catalogue of the United States' sins are the inexperience in foreign lending which led the U.S. to close down on foreign loans in 1928 just before the substantial decrease in imports by the developed countries from the less-developed world; and the Smoot-Hawley Tariff Act of June, 1930, which raised tariffs in the United States to staggeringly high levels, the United States thus "failing to act like a creditor nation."

Critical turning points to support the thesis are found at a number of dates from 1929 to 1933, but perhaps one may single out the British response in June and July, 1931, to the liquidity crises first of Austria and then of

Germany. An international loan of 150 million Austrian shillings (\$21 million) had been arranged in May, 1931, after the revelation of the sad condition of the leading Austrian bank, the Credit Anstalt, and when this proved insufficient an attempt was made to arrange another loan. The French tried to impose political conditions, and the British finally went ahead alone with a loan of 50 million shillings (\$7 million). Much too little, as well as perhaps too late. In July, when the Bank of England was asked to come to the rescue of Germany, the reply was, "His Majesty's Government has loaned to the Continent as much as they conveniently can." This is diplomatic banking language for, "We are broke." The leader, as we shall see, has to be the lender of last resort and must be prepared to lend on a substantial scale.

The United States received many opportunities to serve as lender of last resort in 1931, in concert with France or alone. A positive response was later given by the U.S. on



loans to Britain, when sterling was under attack; but when the web of international finance started to unravel, the United States was able to refuse loans to Austria and Germany by taking refuge behind the political recalcitrance of France. Later, when in 1933 the world looked for a positive program under the leadership of the United States, James Warburg, speaking for President Roosevelt, said that the U.S. was unwilling to throw good money after bad. But that is the essence of leadership: to turn bad money into good by throwing more good money after it.

The Buck Stops Here

The tasks of the leader in the world economic system are five:

- To provide a market for distress goods when goods are in long supply and a source of needed commodities or a system of allocation when they are short.
- To provide counter-cyclical long-term capital movements, or at the least to stabilize the flow of capital through the business cycle.
- To manage exchange rates.
- To coordinate domestic macro-economic policies, monetary and fiscal.
- To act as a lender of last resort, the function we have just referred to for 1931 and 1933.

Under the gold standard, which was to a considerable degree a managed sterling standard operated for the world by the Bank of England, London was the market for distress goods. The City of London managed counter-cyclical lending automatically, increasing foreign loans when there was a recession in Britain and cutting down on lending only when the British economy experienced boom which spilled over to the rest of the world through imports. There was no need to manage exchange rates; the currency of every country was fixed in terms of gold, which means that the currencies were fixed in terms of each other. The gold standard "rules-of-the-game" also provided coordination of domestic macro-economic policies, as countries expanded when they gained gold and contracted when they lost it. And the Bank of England served as the lender of last resort in international liquidity crises, suspending the restrictions on lending which had been imposed in the Bank Act of 1844, discounting freely and paying out gold to all comers. The Bank Act was suspended in the crises of 1857, 1866, 1873, and 1890 (the Baring crisis in which the Bank of France cooperated as lender of last resort). It is of interest that the repeal of the Corn Laws of 1846, which was the

linch-pin of British commitment to free trade, and the Bank Act of 1844 both went back to the period when the British economy was at the peak of its success in the world and before Germany and the United States started to close the gap.

The British economy, exhausted by World War I, was in no position to discharge these functions in the 1920s. Free trade had been abandoned during the war and in tariffs enacted immediately after it. Controls were imposed to prevent capital flows to foreign countries; Britain had barely sufficient capital for its own needs and a weak balance of payments. European countries had been forced to abandon the gold standard during the war, so the gold standard no longer automatically took care of exchange rates and the coordination of monetary policies. Finally, after exchange rates had been painfully stabilized, there remained insufficient gold to permit the resumption of the old system. A gold exchange standard was explicitly adopted which provided that various countries would hold foreign reserves in the currencies of other countries — dollars, pounds sterling, and francs. But the changes in the liabilities of the reserve countries did not produce responses in monetary and fiscal policy as much as gains and losses of gold had moved Britain in the 19th century. Finally, as just recounted, Britain was in no position to act as lender of last resort.

The United States economy had grown in strength in World War I and it was felt natural in Europe that this country should take over the central leadership role which Britain yielded. Bankers in New York — and some leading industrialists as well — were prepared to play a more positive role in international finance. But the rest of the country was not ready. The Senate voted down United States membership in the League of Nations. Republican administrations succeeding Woodrow Wilson's adhered to their old high tariff slogans despite the fact that many large business interests were beginning to export manufactured goods on a worldwide basis, and would have gained from more imports into the United States, the proceeds of which would have generated more exports. Detroit, the world's leading auto manufacturer, was slow to understand the motives which had led Manchester, England, the world's leading textile manufacturer 80 years before, to push hard for repeal of the Corn Laws.

Immediately after the war, the United States raised tariffs in the Fordney-McCumber Act of 1919. War is the greatest protective device of all: during wars new industries are created which may or may not be able to with-

stand competition with the return of peace. The Republicans had no hesitation in putting up tariffs before it was clear whether these war-babies could or should survive. Of much greater interest, however, was the Smoot-Hawley Tariff Act at the other end of the decade. This arose from a promise made by President Herbert Hoover in the 1928 campaign to do something for agriculture. Tariffs were the Republican household remedy, as Harvard economist Joseph Schumpeter said, and there was nothing more natural than to reach for the old bottle. But very quickly tariffs for agriculture became tariffs for all, Democrats joining Republicans before both were pushed aside by lobbyists marking up the bill. The resulting bill was a monstrosity. Thirty-five countries protested its provisions, and 1,028 American economists urged President Hoover to veto it. But the pressure from the interests was so substantial that Hoover signed, uttering a classic statement in economics: "Not every tariff bill is all bad." The Smoot-Hawley Tariff Act has been excoriated for limiting imports into the United States when the foreign debtor countries needed to sell goods for dollars to pay their debt, and that criticism is cogent to a degree. The main count against it, however, is that the bill showed that no one was in control of the United States government — no leader in charge, no place for the buck to stop.

Mistakes: Another Word for Experience

United States lending in the 1920s was pro- rather than counter-cyclical. Foreign lending had started during the war and picked up sharply in 1924 with the success in New York of the Dawes Loan, issued to help the Germans make a new start in reparations. It is sometimes suggested that New York's lending was different from London's because of inexperience, and in a sense that is true: in essence the difference was between learning a new activity and continuing an established one. During the learning process, when the horizon of United States investors had just been enlarged to European (largely German) and Latin American bonds, more savings to invest meant more lending at home *and* abroad. An established lender switches lending between home and foreign borrowers depending upon which is the more attractive at a given time; this can be described as a model in which a given supply is allocated between outlets depending on relative demand. In contrast, the American pattern was to build up foreign lending and simultaneously continue lending at home as varying supplies of savings (ample except in the recessions of 1924 and 1927) permitted. The pro-cyclical character of American experience meant that the

world was cut off from exports to the United States market and loans from it at the same time.

The loss of exports and the unavailability of loans began early in the Great Depression to weaken the structure of exchange rates. Countries like Argentina and Australia had no choice but to allow their exchange rates to decline, and the depreciation began in December, 1929, in Argentina and in March, 1930, in Australia. A change in an exchange rate alters the relationship between the prices of traded goods at home and abroad. In ordinary times, for a small country to depreciate by 10 per cent would raise the price of its exports and imports by 10 per cent and leave world prices unchanged. But with weak commodity markets, and because of the importance of Argentina and Australia in grain, the ordinary effect was not realized. Australian prices in, say, wheat and wool were unchanged, but world prices fell. The depreciation communicated deflation to Canada and to the farm areas of the United States. The fall in agricultural prices put pressure on banks in agricultural areas, and so deflation spread from exchange rates to commodity prices to bank failures.

With the collapse of the gold standard, it was *sauve qui peut*, every man for himself and devil-take-the-hindmost. Competitive exchange depreciation, tariff increases, exchange control, import restrictions — every sort of beggar-thy-neighbor device was followed, and the slight temporary gain of one country was matched by world loss which communicated back to the original gainer and left the world worse off as a whole. The fallacy of composition reigned supreme — the whole was much less than the sum of the parts.

Suggestions of internationally coordinated public works were legion. To have carried them out would have required leadership. For a single country to expand itself worsens its balance of payments and brings losses of gold and foreign exchange. One remedy is to depreciate the exchange rate, but if carried far this dumps the burden abroad. Under fixed rates, recovery required neatly timed expansionary policies in the major countries, which in turn required leadership. None was available. The French did not believe in Keynesian nostrums. The Germans rejected the positive suggestions of a number of their native economists until finally their ideas were adopted by von Papen and Hitler. Roosevelt in the hundred days and through the World Economic Conference fiasco of June and July, 1933, turned inward and away from international programs, relying on a bewildering variety of devices — NRA, work relief, exchange depreciation, print-

ing silver certificates, crop restrictions, and the like — in the hope that one or more of them would help more than the others hurt.

The lack of a lender of last resort — the British unable and the United States unwilling — was the critical factor in the spreading collapse of 1931 and 1932 which drove the world economy to its depths of June, 1932.

Best-Laid Plans

The traumatic experience of the depression and World War II produced a drastic shift in attitudes. As early as the Tripartite Monetary Agreement of September, 1936, and perhaps as early as the Reciprocal Trade Agreement Act of 1934, the United States under President Roosevelt (and Cordell Hull) took a far more positive attitude toward the world economy. In the war years there was a full-blown scheme for preventing the distortions which followed World War I, and there were international agreements on rules for managing the world economy. Lend-lease prevented the accumulation of war debts: short, sharp and ultimately scaled-down reparation agreements eliminated that part of the problem. An Atlantic Charter laid down a broad set of principles under which international institutions would first repair the damage of war and then adopt a mode of behavior capable of being generalized; the United Nations Relief and Rehabilitation Agency, the International Bank for Reconstruction and Development, the International Monetary Fund, and the abortive International Trade Organization constituted the major pillars of the design, with specialized agencies in food, health, weather, communication and the like filling it in. Relief, rehabilitation, and reconstruction would set the world economy on its feet, and thereafter capital for development, rules for managing money and domestic macro-economic policies, and a movement to reduce trade restrictions and tariffs would replace the 19th-century rules of balanced budgets, free trade, and the gold standard.

When the time came to put it into practice, this ostensibly internationally-agreed basis for running the world economy proved to be a disguise for American leadership, just as the 19th-century rules of thumb were cover for British direction. The International Monetary Fund par value system for currencies disguised an essentially dollar standard, as the gold standard had been the role of sterling. The inadequacies of wartime planning required a Marshall Plan and Point IV, and made no provision for international surveillance of a new post-war phenomenon, the multinational corporation, largely United

States-based.

United States economic hegemony broke down for two reasons: it was objected to abroad as exploitative, and it was objected to at home as imposing undue burdens on the United States.

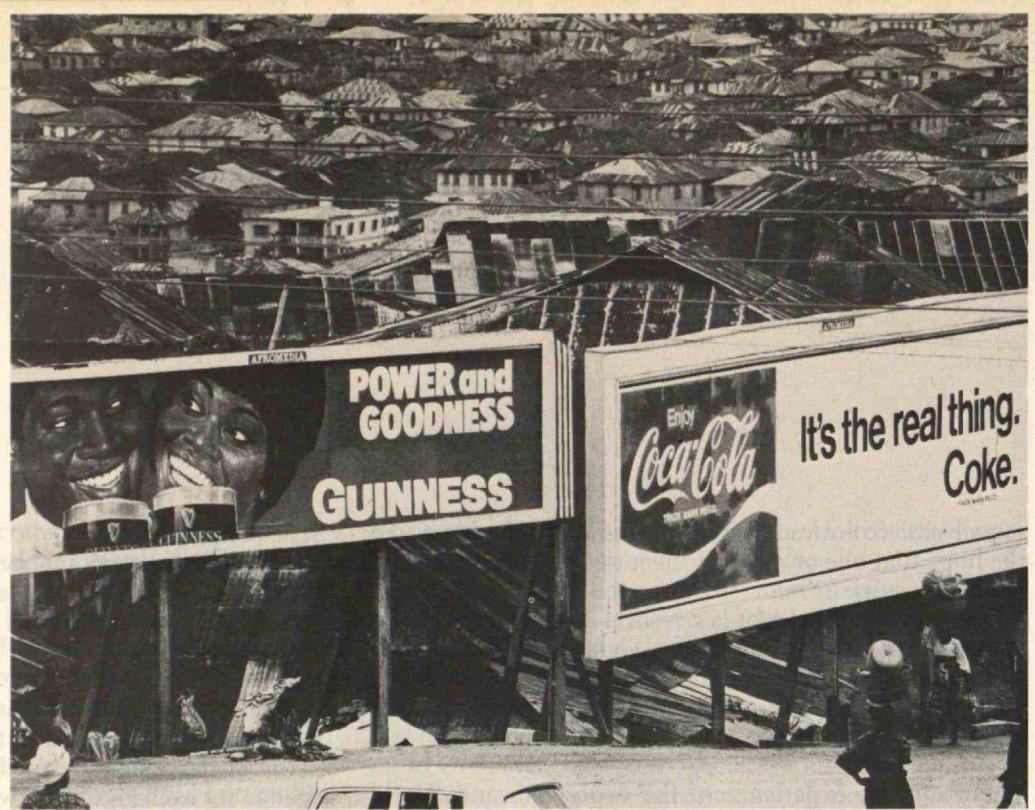
In the post-war period the U.S. has borne a major share of the budgets of international agencies of all kinds, as well as development aid in the early stages.

Under the dollar standard, the United States could not change its exchange rate, whereas others could. Europe was slow to provide room for Japanese goods which in the 1960s poured out of that country and required markets to absorb them, the major role in which had to be taken by the United States. The burden of Japanese goods, especially in textiles and steel, led to the requirement that other foreign countries restrict exports to the United States. Import restrictions had been foreshadowed, but the United States could threaten to impose them unless Japan, Hong Kong, *et al.*, undertook to do its dirty work for it. In the 1968 campaign, Mr. Nixon followed a "Southern strategy" which included protection against imports of textiles from abroad, reminiscent of Mr. Hoover's promise to farms in the campaign of 40 years before. Labor support for free trade dwindled. The trade bill was pursued, but the emphasis was on outlets for farm exports — until the shortages became apparent — rather than on freedom of international markets.

Finally came the Nixon-Connolly shock of August, 1971, when the United States imposed a ten per cent surtax on imports until foreign countries would allow it to adjust the exchange rate of the dollar.

But the problem of the 1970s is by no means entirely one of distress goods. It is also, in part, one of critical shortages. The analogue to providing a market for distress goods is here one of sharing goods in acute short supply. United States leadership in a number of commodities — in wheat, where it irresponsibly sold off the world's inventory to the Soviet Union; in soy beans, where it clamped down export prohibitions to the great distress of the Japanese who depended upon that source of protein; and in oil, where the initial response to the Arab oil embargo was the neo-mercantilist "Operation Independence" belatedly and ineffectively followed by a proposal for international sharing of shortages — was weak or totally absent. The Executive Branch dithered between the national and the international interest, effectively guarding neither, while the Congress turned almost completely away from concern for any other than the narrow national interest.

"The inadequacies of wartime planning . . . made no provision for international surveillance of a new post-war phenomenon, the multi-national corporation, largely United States-based."



The position in stability of capital movements can be said to be mixed. The United States' record of leadership is poor, but the World Bank, under the direction of a dynamic U.S. citizen, Robert MacNamara, came to the rescue. The United States government sought to cut down on capital outflows for balance-of-payments reasons — though without much success and while trying to keep the lines open to less developed countries and to Canada. Over the years it found less and less enthusiasm for foreign aid, which could have substituted for capital exports. Only the efforts of the World Bank keep the record of the developed countries from scoring badly on this item.

With the rise of the price of oil following the Yom Kippur war of October, 1973, the problem of stabilizing the movement of capital changed form. Previously in depression the developed countries had to recycle to the periphery of the world economy the currencies needed to replace their imports at high prices in boom. Now the developing countries were divided into two groups: one, the oil producers and countries producing commodities — sugar, copper, aluminum — with similar astronomic price rises; and two, the others. Superimposed on the necessity for increased or, at minimum, stabilized capital flows for ordinary imports were new capital outflows to pay for oil, sugar, grain, fertilizer, and the like. Recycling of petro-dollars appeared as a separate problem of terrifying proportions, and international bodies and the leading industrial countries were slow to develop means to handle it and did not always converge toward the same solution.

The management of exchange rates was given up in August, 1971, and thereafter as the system proved too painful for the United States to bear. For a time this country followed a policy of "benign neglect," letting foreign countries support the dollar but not caring itself what the exchange was. When the burden on the Bundesbank

proved too great in February, 1973, the United States moved to floating exchange rates, encouraging more depreciation. In July of that year it became clear that the speculators had driven the rate too low, and limited efforts were made by the United States, and stronger ones by the German financial authorities, to raise the rate. But when the oil embargo of October, 1973, gave rise to the prospect that dollars would be in strong demand to buy more oil, the Treasury relaxed all restrictions on capital outflows to depress the currency and keep it from rising. The stability of the system as a whole was given up in favor of a depreciated dollar for the sake of the balance of payments.

As it turned out, there was no repetition of the 1930 experience with "beggar-thy-neighbor" exchange depreciations. One reason was that in a number of countries — Germany, the Netherlands, and until last September Australia and New Zealand — fear of inflation was stronger than fear of unemployment, and there was no resistance to currency appreciation which was implicit in the depreciation of other currencies. In addition, the world is acutely conscious of the danger that competitive exchange depreciation may destroy the coherence of the world economy, and countries have agreed through the International Monetary Fund not to try to improve balances of payments at the expense of other countries.

The gyrations of the dollar have contributed to inflation in this country. In the 1930s, competitive exchange depreciations were deflationary, as each country depreciating in turn forced down world prices without raising domestic prices of internationally traded goods. In the 1970s, with shortages in the world, depreciation raises domestic prices of traded goods without depressing world prices. The ratchet effect of a currency successively depreciated and appreciated is sharply inflationary today whereas it was deflationary 40 years ago.

The largest failure seems to have been in the interna-

tional coordination of macro-economic policies other than the exchange rate. In fact, economists have sought floating exchange rates to achieve independence. Their analysis ran this way: under fixed exchange rates, monetary policies at least were locked into each other in interdependent fashion, because any country with a high interest rate would attract capital and any country with low interest rate would lose capital to others, the flows continuing until the rate of each country approached the internationally determined rate. The collapse of the dollar standard in fact was to a considerable extent the result of the United States and Germany following different monetary policies when capital was free to move between them. With the United States trying to pursue cheap money policies, and Germany dear, funds flowed from the United States to the Euro-dollar market and from the Euro-dollar market to Germany, producing high accumulations of dollars in the Bundesbank. Because in one (international money and capital) market there can be only one price, the United States embraced floating of the dollar to break the connections between the New York, Euro-dollar and Frankfurt money markets, as well as to improve the balance of payments on current account through larger exports and reduced imports. This strategy failed to work. Capital movements did not dry up as the analysis anticipated. Exchange risks proved less important than access to large amounts of dollars. And Arthur F. Burns, Chairman of the Board of Governors of the Federal Reserve System, found himself in error when he said that United States monetary policy was made in Washington rather than in Paris or Frankfurt. Autonomy of monetary policy under floating requires zero capital movements, and this condition was not realized.

Is Hegemony Cricket?

Despite a highly nervous summer in 1974, the need for a lender of last resort has not yet been apparent. Though a succession of bank failures in the middle of the year — the Franklin National Bank, the Herstatt Bank in Cologne, the Sindona Bank in Italy — and huge losses in foreign-exchange trading made the financial community nervous, the international money market did not collapse in panic. For one thing, central banks agreed that each would make good losses to other countries from their banks' inability to meet international commitments. For another, speculators and traders in foreign exchange markets became circumspect only gradually and did not make a mad rush for liquidity.

A new need for a lender of last resort, however, emerges from the petro-dollar crunch, for the deficits created in non-oil countries and the counterpart surpluses of the O.P.E.C. (Organization of Oil Exporting Countries) hold out the threat of beggar-thy-neighbor policies. To take the second point first, a \$50 to \$60 billion surplus of the O.P.E.C. countries, as the less developed among them earn petro-dollars faster than they have learned to spend them, must be matched by a \$50 to \$60 billion deficit in the rest of the world. Any one non-oil country can rid itself of its deficit only by shifting it to another non-oil country, and a world in which each is trying to shift its deficit to another by exchange depreciation, import restrictions, or deflation is a world in trouble. The world has agreed through G.A.T.T. not to try to cure "oil deficits," as distinct from "non-oil deficits" — those that remain after subtracting the oil deficit from the total deficit. But that leaves the first problem of how the

oil deficits are financed, and this may require a lender of last resort.

One suggestion has been put forward to let the oil-exporting countries sell their oil on time, so much down and the rest in five, ten or 20 years. This would leave the producing countries bearing the credit risk of default by the debtors, and some countries are very poor credit risks today: India, Bangladesh, Mauritius, . . . it is invidious to go on. The oil producers would prefer to lend to an intermediary, leaving such intermediary to lend to the deficit countries; they would prefer, for example, to receive claims on Germany, Switzerland, the United States, etc., and have these lend to India, Bangladesh, Mauritius, etc. But the Swiss, to take one example, want no more than the Arabs to hold the dubious claims.

This is the petro-dollar problem with which the world is seized. And it may need a lender of last resort, some leading country such as the United States, which stands up in the final analysis after every other expedient has been exhausted — and there are a dozen or more possible expedients — and says, as the United States said under the Marshall Plan, we will provide the Swiss francs, German marks, or dollars that the oil-exporting countries insist on to prevent the halting of oil deliveries to countries which depend on them.

There is a delicate bargaining problem here, of course. For a United States offer to make up the oil deficits of another country at an early stage of the game would relieve the exporters and the country in question of all responsibility and incentive to find another solution. Blank checks are costly. On the other hand, if there is no contingency plan, no readiness on the part of any country or group of countries to provide the standby rescue facilities needed if some country is unable to qualify as credit-worthy in meeting its oil bills, the world economy may begin to unravel. The Indias, Bangladeshes, etc. — lacking credit standing and unable to meet their oil imports — will need foreign aid. But the weaker among the industrial countries — and again it is a mistake to name names — need a banker. Such a banker takes risks, grave risks, of ending up with uncollectible debts; but the risks of economic collapse may be graver.

The need for leadership in the peace-keeping field is clear. The United States has accepted a responsibility for keeping peace in the Middle East which the countries of Europe as free riders have declined. In 1931 the United States declined to accept any responsibility for stability-keeping in the world economic field. In the world economy today there are some signs that all countries are sharing responsibility for providing the cosmopolitan public good of stability — restraint in beggar-thy-neighbor, cleaning up internal financial messes before they spread abroad. But the petro-dollar problem with its enormous scale poses a threat to the countries of the world, and I think to this country especially — to our analytical powers, our fortitude, our leadership. When each country in the world is a free rider, the world not only goes nowhere; it sinks into the mire.

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Trend of Affairs

Trends This Month

ARCHITECTURE

57

Self-sufficiency begins at home.

MEDICINE

57

Drugs to aid delivery may help the mother but harm the child. . . . A contraceptive "time-capsule" is being developed. . . . Cancer researchers discuss funding. . . . Found: a direct connection between disease and human stress. . . . The "sound" of the artery may predict a stroke.

WEATHER

60

The whens, hows, and whys of weather modification.

ENVIRONMENT

61

Living with lead . . . and with strip mining.

COMPUTERS

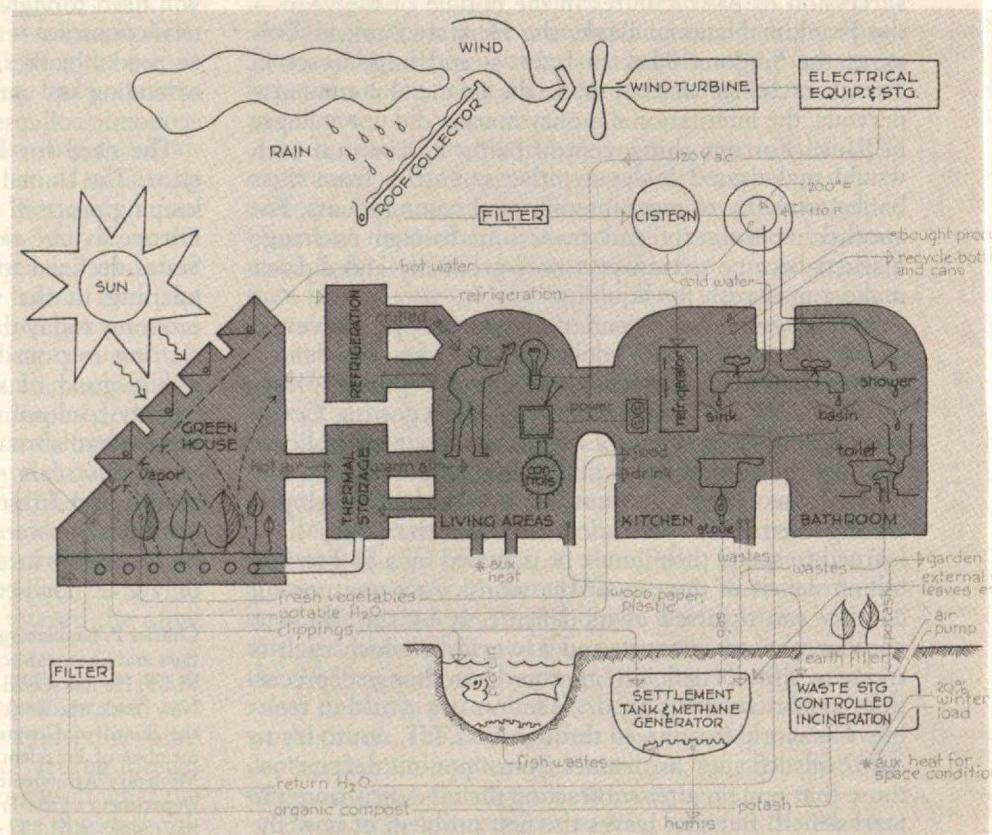
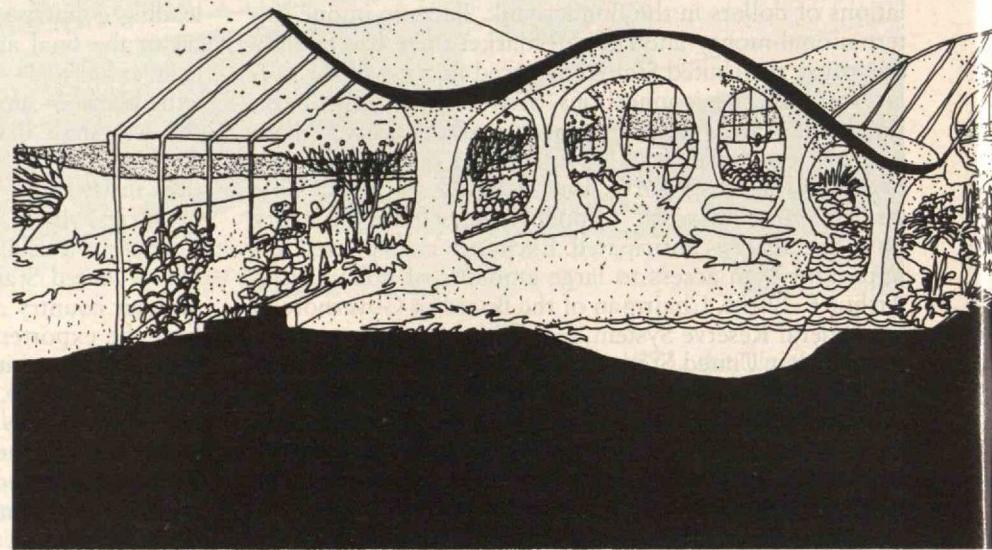
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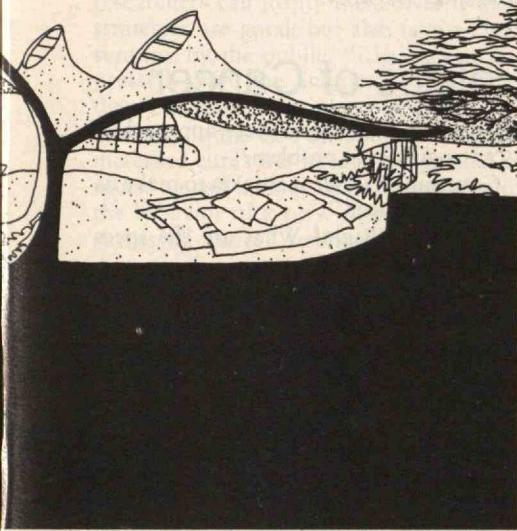
From the minds of hollow-eyed computer addicts come automated factories . . . and automated diagnosticians.

WORKING WOMEN

64

A special section commemorating International Women's Year.





ARCHITECTURE

Technology for the Autonomous House

A man's home may be his castle, but he is hardly autonomous in it. Can one imagine a truly self-contained living system — a house which keeps itself warm (and cool), in which its tenants can grow their own food, dispose of their wastes, recycle their water, and generate their own power?

The dream is still elusive, but one roadblock may now be conquered. After at least ten years of study and experiment in polymer physics, Day Chahroudi, who is associated with the Architecture Department at M.I.T., has patented a multi-layer polymer material which transmits just over three-quarters of the short-wave solar radiation which falls on it but which is "virtually opaque" to long-wave thermal radiation — another way of saying that it is an excellent heat insulator.

Now Mr. Chahroudi and an M.I.T. colleague, John Brooks, Research Associate, are experimenting with a "cloud gel" backing for the plastic which would become opaque at high temperatures. The goal, of course, is to make a plastic structure which would collect solar heat and light until its interior reached a certain maximum temperature, then automatically turn opaque to reject further heat.

In the end the two designers conceive a self-sufficient, "autonomous" house with a windmill for generating power above a modified "greenhouse" in which space heating and cooling, plant and protein production, and water purification would be accomplished. Computer simulations are now in progress to help define the various requirements, and Mr. Chahroudi and Sean Wellesley-Miller, Visiting Assistant Professor at M.I.T., hope soon to build a "pavilion" in which they will in fact live to test their plastic material and their "autonomous" house concept. But they agree that the idea has limitations. "It smacks a little of the ecological bomb shelter," they write in *Architecture Plus* magazine, "as an insurance policy it fails

to recognize our collective responsibility for the natural environment." So the eventual goal may be an "autonomous" community instead of a single "autonomous" house. And even if you still think this sounds a bit fanciful, you can hardly fail to agree with Messrs. Wellesley-Miller and Chahroudi when they write (with Marguerite Vilecco) in *Architecture Plus* that "the new technologies of solar climate control, energy conservation, and environmental protection are likely to have as much impact on the way architecture looks and functions in the future as the development of steel, glass, and concrete technologies did on the architecture of the 1920s." — J.M.

MEDICINE

Drugs and the Newborn

Some say that being born is the most psychologically traumatic of any experience in our lives. Why else would none of us remember it? And modern obstetrical practices, designed to ease the mother through birth, may increase an infant's difficulties.

Administration of analgesics to mothers in labor, which decrease sensitivity to pain, and anesthetics, which deaden an area of the body, is a common practice. Doctors are aware of the possibly harmful effects of high dosages of such drugs, but local anesthetics and relatively mild analgesics have not been thought to affect the newborn.

In a study of 60 births, controlled for prenatal care and difficulty of delivery, researchers from the National Institute of Health and Human Development in Bethesda, Md., found statistically significant differences in the alertness, irritability, and motor maturity of infants whose mothers had received such medication. Writing in *Science* (November 15, 1974), Kay Standley, A. Bradley Soule III, Michael Duchowny, and Stuart Copans found these differences in infant behavior as late as three days after birth, even

These drawings show how Day Chahroudi, Research Affiliate in Architecture at M.I.T., might create a home which is an artificial eco-system, cutting "the umbilical cord to the utility networks." A "solar membrane" of material devised by Mr. Chahroudi is inserted into opaque material covering a pavilion; beneath are a greenhouse and aquaculture system in which food is grown, thermal collection, storage, and distribution plants, cooling system, a methane generator to convert waste into fuel, a water supply system, and electrical supply and storage based on a wind turbine to provide lighting, communications, and power for necessary appliances. Mr. Chahroudi and his colleague, Professor Sean Wellesley-Miller, admit in *Architecture Plus* that their concept is "still very young, still very experimental, and obviously has a long way to go before it could ever become widespread." But they think it represents "a radical and potent change in the concept of a dwelling." (Drawings: Michael Epp from *Architecture Plus*)

though no evidence of the drugs in the newborn had been detected after 24 hours.

While the most alert, most coordinated, and least irritable babies had not been exposed to medication, and exposure to anesthesia produced the least alert and most irritable babies, all the infants measured were considered within the normal range.

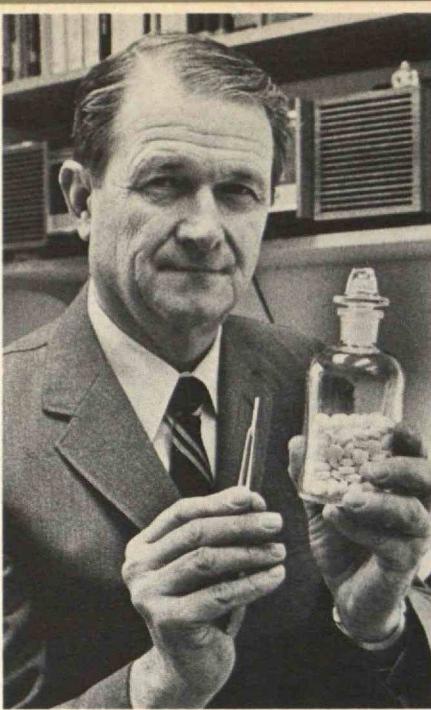
Researcher Kay Standley was unable to say whether these drug-related variations in behavior would significantly affect the later development of the infant. "It is more important," she said, "to be aware of the variations, their possible causes, and control for them." Three possible explanations for the behavior variations were offered:

— Possibly the medication, no longer detectable in the circulation, "could be found at sites in the central nervous system," and continue to be expressed.

— Or the drugs themselves could have had no effect if "the use of anesthesia is related to the difficulty of labor and delivery" and the amount of difficulty has a direct affect on newborn behavior.

— Approached psychologically, "aspects of the mother's personality having to do with her need for medication" could have determined the newborn's temperament.

The research group is careful to make no across-the-board judgements on the effects of analgesics and anesthetics on the infants. Yet the results indicate, said Dr. Standley, that "even within normal delivery circumstances we need to be alert." — S.J.N.



One implantable capsule or 252 birth control pills? Paul M. Newberne of the M.I.T. Department of Nutrition and Food Science compares the once-a-year biodegradable contraceptive capsule which he and his colleagues are developing with a year's supply of conventional oral contraceptives.

The Once-a-Year Pill

Pioneer women sometimes used a small sponge dipped in vinegar as a primitive and somewhat ineffective means of contraception. Much more recently it was confirmed that small amounts of the hormone progesterone work on the same principle. Progesterone, or its chemical derivative norgestrel, alters the chemical balance of the uterine wall to make it un receptive to sperm and thus aids in the prevention of pregnancy.

Some birth control pills, and presumably all IUDs, instead of disrupting the ovulation cycle, work on this concept. But a pill a day is an erratic way to administer drugs. The level of medication in the body jumps just after the pill is taken and decreases to almost nothing within 24 hours, as attested by those who have missed a pill at the wrong time. More practical would be a pill that is more of a time capsule, slowly and steadily releasing its ingredients over long periods of time.

A contraceptive capsule that can be implanted under the skin is being developed by M.I.T. Professors Paul M. Newberne and John B. Stanbury, with the assistance of graduate student Yutta Salinas. Made

of polyglycolic and polylactic acids (polymers of naturally occurring body metabolites), the capsule will slowly dissolve in the body. Steady release of the norgestrel, a contraceptive chemical developed by the Wyeth Co., is assured by the predictable "unwinding" of the polymeric chain that binds the norgestrel.

The biodegradable polymers, developed by John B. Gregory and Donald L. Wise of the Dynatech Research and Development Co., have already successfully passed tests in female beagles. Remaining to be tested are the possible reactions resulting when the two are mixed and implanted for up to two years.

First results are encouraging. Tests on the urine of beagles show no irregularities in the release of the norgestrel, and the drug completely disappears from the animals' systems within 8 to 12 months after insertion, depending upon the concentration of the drug and the ratios of the polymers. Further, the dogs have not been noticed to scratch or aggravate the suture that covers the 2-inch long, pencil-thin capsule. If women eventually have capsules such as these inserted under the skin on any part of the body, this bodes well for their comfort.

Dr. Newberne anticipates at least two or three more years of animal research before testing in human subjects begins. If future tests are successful, the method is

expected to find quick public acceptance. "The convenience of the implantable, biodegradable capsule would be a tremendous advantage," Dr. Newberne said. Unlike non-dissolving capsules, the implant will completely disappear. Its effects are reversible over time, and insertion should be quick and relatively painless, equivalent to receiving a hypodermic injection. He expects this type of drug delivery system to become valuable also in treating diseases that require sustained medication, such as diabetes or malaria.

"The fact that we are concentrating on contraception only for the woman has become a bone of contention," apologized Dr. Newberne. "This method of treatment will work equally as well in men as soon as a comparable male contraceptive is found." — S.J.N.

Politics of Cancer

What if cancer research were approached as an engineering problem?

Government: "We want you to make us a cure for cancer."

Engineer: "Right! What are the specs for this cure?"

Government: "We don't know; you have to develop them, as well as make the cure."

Engineer: "Right! What exactly do you want me to cure?"

Government: "We don't know, but if you want our money you've got to tell us what it is and how you're going to cure it beforehand."

Although the dialogue may be a bit overplayed, there is considerable political jousting over cancer research funding and this was a principal theme of a symposium in March commemorating the dedication of the Seeley G. Mudd Building, M.I.T.'s Cancer Research Center.

The conclusion, as is usual at such meetings, was that scientists must avoid promises and continue to do the best science they can; but there were some interesting scuffles among the participants on the way to that conclusion.

Michael G. P. Stoker, Director of Research for the privately-funded Imperial Cancer Research Fund in London, advocated listening closely to the donors of cancer research money as well as research committees and scientific peers. Dr. Stoker condemned two kinds of pressures on research aims: pressure from the conviction that cancer researchers should choose topics that might apply also to population problems and hunger, because cancer is trivial compared to the other enormous problems of mankind; and pressure to aim at the great unsolved problems of biology surrounding cancer cures, rather than aiming immediately at the cures themselves. These pressures detract from the scientific responsibility to follow donor's wishes to attack cancer.

Dr. Stoker delineated two classes of

cancer research — strategic and tactical. Strategic research, such as research on cell differentiation, is basic research that has only some relevance to cancer. Tactical research, such as tumor virology, is that which directly applies to cancers.

"There is a continuous gradient of relevance of biological research to cancer, but there is a point on that gradient at which cancer goes from being one beneficiary, to being the major beneficiary," said Dr. Stoker. We should limit cancer research to projects on the "major beneficiary" side, he said. He favored a portion of cancer research funds being set aside to help pay for research adding to the pool of knowledge of general biology.

David Baltimore, Professor of Microbiology at M.I.T., feels that cancer researchers can justify themselves if their strategies are good, but also favors close scrutiny by the public. "I have been impressed with the importance of non-directed research to cancer research. For instance, in the case of Hodgkin's disease, increased cure rates have not depended so much on cell biology as on knowledge of the behavior of x-rays. Thus, in this case successful cancer treatment was dependent on physicists, not biologists.

"We should not try to second-guess the donor about what is important, but should devise optimal strategies to solve pieces of the cancer problem," he said.

While supporting the notion of excellence in pure research as a goal, James D. Watson, co-discoverer of the structure of DNA, launched a lengthy diatribe against the government's \$600-million National Cancer Program, which has resulted in an approximate doubling of cancer research funds since 1971.

He praised M.I.T.'s efforts in founding its Cancer Center, noting that "they alone have acted sensibly," but warned that "they now have the burden of seeing that something sensible happens" at M.I.T.

But he termed the massive research plan developed under the auspices of the National Cancer Institute "a total sham, so thick that no one with any intelligence would read it . . . and it didn't distinguish between the merits of the various leads" to curing cancers.

The sixteen comprehensive cancer treatment and research centers established around the country under the National Cancer Program, he said, "started out lousy, and will probably stay lousy."

Perhaps Dr. Watson was right when he termed the National Cancer Plan "a catalogue of wishful thinking," but could any cancer researcher mindful of the vagaries of research ever pretend it was anything but a political document? — D.M.

Hip, Hip, Hippocrates

Hippocrates' view, that disease is caused by a person's loss of equilibrium with his total environment, was banished by the

"germ theory" of disease advanced by Pasteur and Koch in the 19th century.

Although the idea of germs entering the body, multiplying, and wreaking havoc was immensely effective in explaining and treating the diseases of that period — plagues and poxes — it is not as useful to explain today's killers — heart disease, cancer, stroke, and mental illness.

Hence, scientists are returning to Hippocrates' global view of disease to explain and treat today's diseases, according to scientists at the January annual meeting of the American Association for the Advancement of Science, held in New York. Stress caused by various social problems has been linked epidemiologically with a host of diseases, not only chronic, but also microbial in nature, according to Dr. Elmer L. Streuning of the New York State Department of Mental Hygiene.

In an extensive review of the subject Dr. Streuning linked high disease rates to living alone, being a member of a minority group, and having a status inconsistency — for instance, being an older man without a job, or an unmarried mother. In all these cases stresses are created that can result in vulnerability to diseases ranging from tuberculosis to schizophrenia. Rapid urbanization, geographical mobility, economic adversity, "improvements" in life-quality, and any other developments requiring change, adaptation, or defense create a climate for disease, many studies show. And, as is popularly known, personal life changes, such as a new job or the death of a spouse, have also been linked to higher disease rates.

Another researcher at the meeting, Dr. Marvin Stein, demonstrated how stress may be translated by the body into disease: it operates on the immune system to make a person physiologically vulnerable. While the stressed person's immune system in some cases underreacts, failing to protect him from invading bacteria and diseases, in other cases the system over-reacts. This may contribute to the "autoimmune" diseases — rheumatoid arthritis, hemolytic anemia, and ulcerative colitis, in which the body literally attacks itself.

Mice and monkeys exposed to stress-inducing electric shocks over a long period were more susceptible to a number of viral diseases, including herpes simplex, polio virus, and tumor viruses, said Dr. Stein, Chairman of the Department of Psychiatry at Mount Sinai School of Medicine. Similarly, frequent handling of young mice after transplantation of lymphoid leukemia shortened their survival times.

Animal studies also bear out the findings in humans that crowding may increase stress-related disease: mice living in groups have significantly lower numbers of disease-fighting antibodies in their blood streams than do isolated mice, and the lower the social rank in a group, the lower the antibody count.

Dr. Stein cited physiological studies which linked lower functioning of spleen cells — an important part of the immune system — with high stress.

The doctors established a link between the brain and the immune system when they found that overreactions of the immune system were far fewer in guinea pigs when surgical lesions were induced in the hypothalamus. This portion of the brain is generally considered the regulator of involuntary or autonomic functions of the body — glandular functions and heartbeat. It is unclear, however, whether such a lesion directly or indirectly affects the immune system.

What do these findings mean for the individual? Dr. Neal E. Miller, of Rockefeller University, hiked himself out on a scientific limb to apply his animal research findings to humans. Dr. Miller, a pioneer in studying the purposeful control of autonomic functions, has done extensive research in which rats were exposed to shocks to their tails. The animals had varying degrees of control and warning.

If rats knew the shocks were coming, they were less fearful between shocks, and experienced fewer stomach lesions caused by nerves. Thus humans should recognize and contemplate the danger ahead of them, said Dr. Miller; no head-in-the-sand.

Rats which could regulate or avoid the shocks each time experienced fewer lesions than those which could not. So if humans do something to reduce the "danger" or source of stress, they will handle it better.

Rats suddenly shocked while running to get food stopped in their tracks; those gradually exposed to the same shock kept going, eventually reaching their goals. Humans should gradually work themselves up to a stress, letting themselves become accustomed to it and allowing their bodies to gear up to producing norepinephrine, an adrenal hormone, to function in the face of the stress.

Mild stress is not necessarily to be avoided, said Dr. Miller. In fact, meeting mild stresses — overcoming obstacles — creates a level of norepinephrine in the body that elevates one's mood, "sets one up." So keep on punching, he advises, and you'll feel better. — D.M.

The Fateful Sound of a Coming Stroke

When fatty deposits clog the carotid artery, the main conveyor of blood from the heart to the brain (atherosclerosis, the underlying disease process, affects millions of people), a stroke is a common result.

Now an acoustical method promises to substitute effectively for the far more cumbersome arteriography techniques for determining the condition of this vital artery.

Reporting on successful tests of "phonoangiography" in 48 patients at Massachusetts General Hospital, James O. Gruber, an M.I.T. graduate student, told the annual meeting of the American College of Cardiology early this year in Houston that the new system could dependably measure narrowing when the artery has been reduced to one-half or less of its normal size. The advantage is phonangiography's simplicity: to perform the test, a physician simply places a sensitive microphone on the patient's skin over the artery; the sound of blood flow, recorded on tape, is later analyzed by computer to show the speed of flow, and then the artery size is easily determined.

Arteriography, the conventional method, involves threading a catheter into the patient's artery and injecting a special dye which, in x-ray pictures, reveals precisely the dimensions of the artery through which the dyed blood flows.

Dr. Robert S. Lees, who is Director of the Arteriosclerosis Center at M.I.T. and of the Non-Invasive Diagnostic Laboratory at Massachusetts General Hospital, and C. Forbes Dewey, Jr., Professor of Mechanical Engineering at M.I.T., have worked with Mr. Gruber on the project. Dr. Lees thinks that phonoangiography will be a useful screening technique to quickly identify patients whose diagnosis may later be completed by arteriography.

Unconstricted, the carotid artery measures roughly 8 mm. — about $\frac{1}{3}$ in. — in diameter. Data obtained by phonoangiography agreed with that obtained by arteriography to within 1 mm. in about 80 per cent of the cases in the M.G.H. tests.

The next goal of Professors Lees and Dewey is to apply the same acoustic technique to examinations of the aortic valve, through which blood leaves the heart, and the femoral artery which feeds the legs. The work, in which the Charles Stark Draper Laboratory, Inc., is associated for computer developments, has been supported by the Charles A. King Trust, the National Dairy Council, the National Heart and Lung Institute, and the Ambrose Monell Foundation. — J.M.

WEATHER

Whither Weather Mod?

Fortunately, meteorologists, like everybody else, are still talking a lot about the weather, but doing little about it. There is far too little information and not enough national and international government structure to begin advertent weather modification on a large scale with any confidence, said meteorologists at the annual meeting of the American Association for the Advancement of Science.

So, the several symposia on climate modification dealt mainly with establish-

ing organizational goals to assure that weather modification is used wisely.

"A new view of the importance of the atmosphere as a resource is emerging," according to Wendell A. Mordy of the Center for the Study of Democratic Institutions in Santa Barbara. "A dynamic system, it is the most pervasive, the most immediately essential to life, and probably at the same time the most sensitive and fragile part of man's physical environment."

Mr. Mordy called for the establishment of a world-wide weather authority, an enlargement of the present U.N. World Meteorological Organization. Such an authority would have not only present data gathering and analyzing responsibilities but also the government of international weather-managing activities, and perhaps even rule-setting for local weather modifications.

It may take a Weather Non-Proliferation Treaty, similar to the Nuclear Non-Proliferation Treaty, to head off ill-considered climate modification schemes, suggested Stephen H. Schneider of the National Center for Atmospheric Research. The temptation to attack the problems of famine by weather modification may make it especially important to get such a treaty moving, before nations have the capability for such experiments. And "the spectre of geophysical warfare is not that far down the road," he warned. "Unlike the case of nuclear technology, which was unleashed on humanity before all its side effects were widely appreciated, we still have some time left to steer the course of our developing ability to tamper with the climate." — D.M.

Witless Weather Mod

Although the spectre of weather manipulation and weather weapons was an important concern to meteorologists at the A.A.S. meeting, the conferees concurred that inadvertent weather modification has already occurred on a massive scale in this country.

As much as 60 per cent of the population of this country lives in a man-altered climate, estimated Mr. Mordy. The increasing urbanization of the country and waste heat and pollutant disposal in the atmosphere were among the inadvertent weather-changers mentioned. These widespread effects will certainly make the next two decades a period of figuring out what we have already done to our atmosphere, concluded the scientists.

The extent of inadvertent weather modification was emphasized by a report on the METROMEX program (Metropolitan Meteorological Experiment) conducted in St. Louis, Missouri, to determine the effect of an urban area on weather patterns.

Stanley A. Changnon of the Illinois

State Water Survey reported conclusions gleaned from the project's 14 networks of weather instruments, totalling 1,000 instruments, over a 2,100 square mile area, operating for four years.

As with other cities, the buildings, pavement, pollution, and heat generated in St. Louis affected a wide range of weather factors — solar radiation, temperature, visibility, humidity, wind speed and direction, cloudiness, precipitation and atmospheric electricity. Urban areas, he said "at times have similar impacts as a volcano, a desert, and as an irregular forest."

For instance, cities create an urban heat island, because they create more heat from combustion, store more in their structures, and lose less by evaporation than the surrounding countryside. Not only does this heat island extend vertically for thousands of feet, but may exist far downwind as a "thermal plume."

Because of such complex effects, up to 25 per cent more summer thunderstorms and rainfall occurs near the city, and hailstorms have increased in frequency and severity from 50 to 300 per cent as compared with the rural surroundings.

We should begin to understand the weather-changing effects of our activities by making their investigation a part of the requirements for impact statements submitted for major projects under the 1970 National Environmental Policy Act, said Volker A. Mohnen of the Atmospheric Sciences Research Center of the State University of New York at Albany.

"President Ford's proposal, calling for 200 nuclear and 150 coal-fired plants offers a good example of the necessity for a national strategy in weather modification," said Dr. Mohnen. At present an environmental impact statement is required for each power plant, he said, but additionally the total effects of the plants must be considered, especially as regards weather modification.

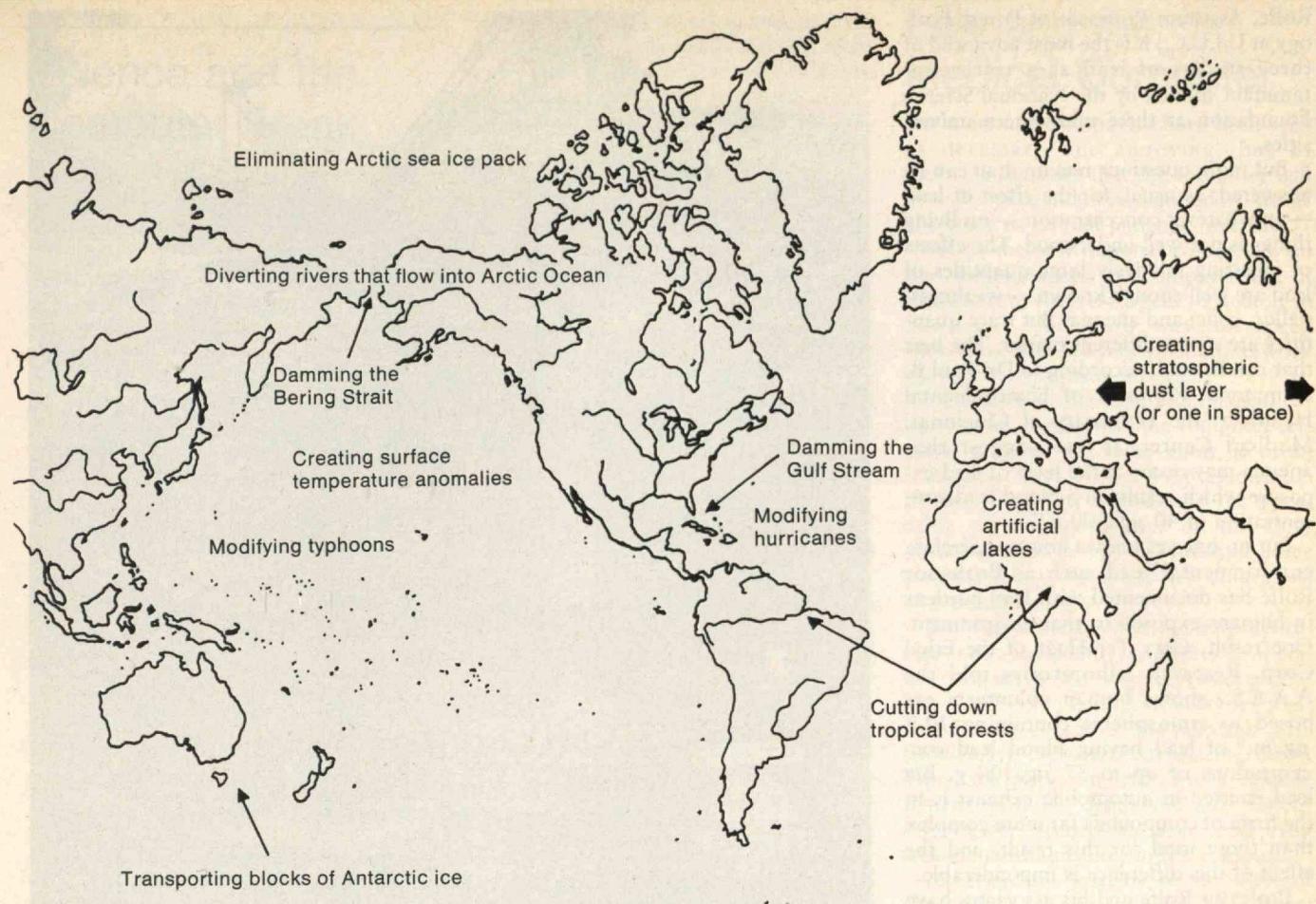
Sulfur dioxide from coal-fired plants, for instance, is thought to be responsible for the acidic rain recently found to be prevalent in the northeast U.S. Would a massive infusion of new coal-fired plants affect crops, and even building deterioration, via an acid rain? — D.M.

... And a Tragic Example

The saddest case of man's inadvertent modification of weather may have been the devastating droughts which recently struck the Sahel area in northern Africa (see *October/November, 1974, p. 73*).

The droughts could have resulted from the recently enlarged cattle and goat herds of the area stripping the land of its vegetation, according to Jule G. Charney, M.I.T. Professor of Meteorology, in the February 7 issue of *Science*.

The key to the drought was the change



Although these world climate modifications have been proposed by various weather scientists, it is widely recognized that far too

little knowledge and political framework now exist to accomplish them wisely, said scientists at the recent AAAS meeting.

in albedo, or surface reflectivity, said Professor Charney, and his colleagues Peter H. Stone of M.I.T. and William J. Quirk of N.A.S.A.'s Institute for Space Studies.

The large herds, which have developed over the past few years, stripped the land of its plant life, increasing the reflectivity of the ground which in turn caused a larger fraction of incident sunlight to be radiated back into space. This reflection produces a relatively cool layer of air above the hot ground which sinks, compresses, and becomes hotter and drier. This layering discourages the vertical air currents that produce cumulus clouds and eventual rainfall. So less plant life means less rainfall, which means less plant life.

Professor Charney and his colleagues tested their theory using N.A.S.A.'s computer model of atmospheric circulation. They plugged in an albedo of 14 per cent reflectivity, equivalent to a plant-covered ground, and then compared the results with those obtained by changing the albedo to 35 per cent, representing a denuded landscape.

The result was a 43 per cent decrease in rainfall, wrote the scientists, which agreed

closely with the actual decrease in rainfall in the area over the last six years.

Professor Charney is planning further studies of the relationship between surface albedos and rainfall. If they confirm the present theory, strict controls will be necessary for farming and grazing on the fringes of desert areas.

The final and perhaps most distressing irony is that the enlarged herds which stripped the land were made possible by plentiful water from deep wells — wells funded by the U.S. and other Western countries who thought they were doing the region some good. — D.M.

ENVIRONMENT

Lead: An Uncertain Hazard

Champaign-Urbana is a medium-sized urban complex (population, approximately 100,000) on the rich, flat prairies of Illinois. It is part of an 86-mi.² watershed drained by the Saline Branch of

the Vermilion River.

Into this 86-mi.² area are emitted from automobile exhaust pipes each month some 2,500 kg. of lead — 73 per cent of it into the area of Champaign-Urbana.

Some of these tiny particles are carried away by winds. The Vermilion River bears away 1,000 kg. of lead — mostly in suspended solids — every year; this is only 3 per cent of the lead input from automobiles. The rest of the 1,000 kg./mo. stays behind.

Along heavily-travelled urban streets, lead concentrations in soils nearest the pavement may be as high as 2,300 p.p.m. The lead content of plants growing in such soils may be as high as 680 p.p.m. Bottom sediments of the Saline Branch show lead concentrations up to 4,000 p.p.m. Street and house dust in Champaign-Urbana contain 8,000 p.p.m. and 4,500 p.p.m., respectively, of lead.

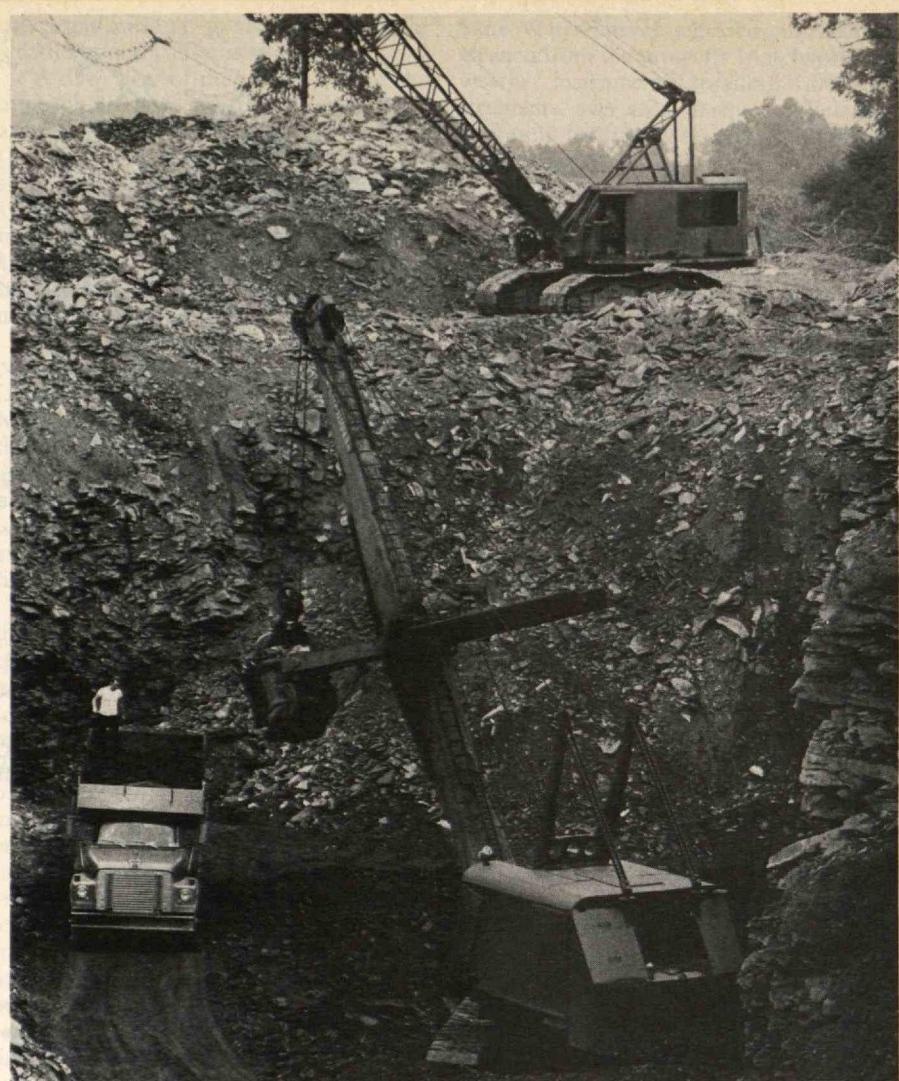
All this data, assembled over several years of study by an interdisciplinary team of scientists at the University of Illinois at Urbana-Champaign, was reported to the American Association for the Advancement of Science this winter by Gary L.

Rolfe, Assistant Professor of Forest Ecology at U.I.U.C.; it is the most advanced of three studies of lead as a trace contaminant funded by the National Science Foundation at three midwestern universities.

But more questions remain than can be answered, as usual, for the effect of lead — in whatever concentration — on living things is not well understood. The effects of ingesting relatively large quantities of lead are well enough known — weakness, pallor, colic, and anemia. But trace quantities are a very different matter. The best that can be said, according to Dr. Paul B. Hammond, Professor of Environmental Health at the University of Cincinnati Medical Center, is "to suggest that anemia may occur at the level of lead exposure which results in a blood lead concentration of 40 $\mu\text{g}/100 \text{ g}$."

But no one yet knows how to correlate environmental lead such as Professor Rolfe has documented with lead burdens in humans exposed to that environment. One result, Gary Ter Haar of the Ethyl Corp. Research Laboratories told the A.A.A.S., shows human volunteers exposed to atmospheres containing 10.9 $\mu\text{g}/\text{m}^3$ of lead having blood lead concentrations of up to 37 $\mu\text{g}/100 \text{ g}$. But lead emitted in automobile exhaust is in the form of compounds far more complex than those used for this result, and the effect of this difference is imponderable.

Professor Rolfe and his associates have found no evidence of food chain magnification of lead. They report "no apparent effects" of the lead concentrations on biota in the Illinois area they have studied. But they are concerned about the soil and plants with high lead concentrations near major highways, and they think street and house dust concentrations "are very high and may result in human health problems." — J.M.



The environmental penalties of strip mining — especially in its most primitive form — have been widely publicized. But deep mines have their environmental costs, too: mine drainage and subsidence may continue for decades after mining has

ceased, and the total long-term cost may in fact be higher than that of stripping, thinks Professor Lee W. Saperstein of the Pennsylvania State University. (Photo: Cary Wolinsky from Stock, Boston)

An Environmental Vote for Stripping

However you do it, coal mining has its environmental toll. And the difference between strip and deep mining may be more in the timing of that cost than in its magnitude.

Strip mines impose their environmental costs almost immediately in ways that are familiar to all of us — disruption of vegetation and drainage systems and destruction of land forms. The expense of land restoration is high, but the job can be done; indeed, says Lee W. Saperstein, Associate Professor of Mining Engineering at the Pennsylvania State University, restoration may well yield "a surface of higher utility than existed before."

The environmental cost of deep mines takes the form of subsidence of the earth's surface above mines, mine fires, mine refuse, mine drainage, and wasted coal. And

all these are hard to control in the measurable future — and harder by far in the distant future, Professor Saperstein told the American Association for the Advancement of Science in New York this winter.

Perhaps two million acres of land show subsidence effects from coal mining in the U.S., and 158,000 acres of this land is in cities where the effects are serious, even tragic. Preventing future subsidence is almost impossible, said Professor Saperstein.

So is preventing future mine drainage resulting from chemical reactions between pyrite, air, and water in an abandoned mine. And if the mine is dry, then the danger of fire in the unmined pillars of coal replaces the danger of drainage. On the average, only 57 per cent of the coal tapped by an underground mine is re-

moved (the recovery factor of surface mining is 80 per cent); the coal which remains in the ground unmined is rendered inaccessible, becomes an environmental liability instead of an asset, and has to be replaced by new coal mined elsewhere. Between 20 and 50 per cent of the material brought to the surface from an underground mine is refuse, and there is no obvious and accepted way to dispose of it as there is in surface mining backfill processes.

Professor Saperstein takes note of "frequent public comment that deep mining is preferable to surface," and he denies it. Indeed, he contends that, in the case where no economic advantage is immediately obvious for either method, "surface mining, from an environmental consideration, is better." — J.M.

Science and the Computer Freak

"Wherever computer centers have become established . . . bright young men of disheveled appearance, often with sunken, glowing eyes, can be seen sitting at computer consoles, their arms tensed and waiting to fire their fingers . . . When not so transfixed they often sit at tables strewn with computer printouts over which they pore like students of a cabalistic text. They work till they nearly drop, twenty, thirty hours at a time. Their food, if they can arrange it, is brought to them . . . If possible they sleep on cots next to the computer. Their rumpled clothes, their unwashed and unshaven faces, and their uncombed hair all testify to their obliviousness to their bodies and to the world in which they move."

Junkies in the computer room? Acid-heads at the console? No, they're computer bums, compulsive programmers, as described by Dr. Joseph Weizenbaum, M.I.T. Professor of Computer Science.

A veteran of many computer installations, Dr. Weizenbaum described the peculiar world of the computer bum to an audience at Lincoln Laboratory.

In contrast to the professional computer programmer, who works carefully and systematically, the compulsive programmer flings together programs, propping them up with quick fixes when they don't work. Rather than seeing the computer as a tool, he sees himself locked in a power struggle with the machine.

In spite of his tinkering, chaotic approach, the computer bum is usually tolerated around computer installations: "He is usually a superb technician, moreover one who knows every detail of the computer he works on. He can write small subsystems quickly, that is in one or two sessions of, say, 20 hours each.

"His position is rather like that of a bank employee who doesn't do much for the bank, but is kept on because only he knows the combination to the safe."

The compulsive programmer would normally be but an interesting oddity, but Dr. Weizenbaum discerns in him an example of a flaw affecting all science.

"The compulsive programmer is convinced that life is nothing but a program running on an enormous computer and that therefore every aspect of life can be explained in the programming terms."

"Many scientists . . . also believe that every aspect of life and nature can finally be explained in exclusively scientific terms."

The affairs of the world appear to be in the hands of technicians whose attitudes closely approximate that of the compulsive programmer, warns Professor Weizenbaum.

The spirit of scientific inquiry, he says,

"must include an acute awareness that there is an outer darkness and that there are sources of illumination of which one as yet knows very little." — D.M.

The Blue-Collar Computer

What many engineers dub "a new industrial revolution" in which primitively "intelligent" computers will take over many manufacturing tasks previously reserved for humans is fast approaching.

Behind the predicted revolution in computer-managed manufacturing are economics. Solid state electronics has driven down the prices of computers and human labor is becoming enormously expensive, said Michael L. Dertouzos, Professor of Electrical Engineering and head of M.I.T.'s Project MAC, at a conference on the "Future Impact of Computers on Manufacturing," held at M.I.T. in November. Moreover, computers will soon have fairly advanced sensory capabilities — the ability to see and touch to perform complex assembly line tasks previously reserved for people. Computerized robots could work faster, more dependably, and could use expensive manufacturing machines more efficiently, agreed the conference participants. Few industrialists at the conference doubted that computers would eventually take over factories; only the speed of the conversion would be subject to outside forces, such as the severe economic downturn now being experienced by industry or labor objections to automated factories.

Almost every sociological advantage cited to justify computerized manufacture has elements of irony

With computers, people could escape the dehumanizing monotony of the assembly line and become supervisors of the efficient, economical machines. But conversely, computers would clearly throw a great many people out of work, perhaps more severely than during the early stages of mechanical automation in the 1950s.

Further, although the computer-run factory would have little need for personnel, it would require more energy and materials resources. But manpower is the only resource on earth that is growing, pointed out M.I.T. Professor of Mechanical Engineering Thomas B. Sheridan.

One less gloomy irony lies in the computer's ability to sort the many commands involved in tailor-made products. Such flexibility could allow industry to return to the creativity enjoyed by 18th century artisans, permitting all sorts of commonly mass-produced items to be custom-made. A small comfort, Dr. Sheridan concluded. "Copernicus told us we are not the center of the universe; Darwin told us we were animals; placing our trust in robots may be the coup de grâce." — D.M.

Law and the Medical Computer

For most uses computers have been seen as necessary but annoying, but in medicine signs are that the computer will be welcomed, and even required by law as necessary to give all patients "due care."

So, at the first national conference on the "Legal Aspects of Computer Use in Health Care Delivery" held in Boston in November, the word was full speed ahead, but with lawyers on board to work out legal problems in advance.

According to the legal and medical experts at the conference, the computer certainly presents the same kinds of problems that have cropped up elsewhere. Privacy of patient records and the possibility of overdependence on the computer, similar to the over-testing some physicians have been accused of, are just two examples.

But happily for today's malpractice-suit-conscious doctor, suppliers of medical computers and programs will probably take the major responsibility for their functioning, except for the physician's responsibility to watch for glaring error. Thus, the physician will have a reliable patient monitor, diagnostic aid, patient interviewer, record-manager, and even treatment administerer in the computer.

Experimental systems to do each of these things are now in use in laboratories around the country. Dr. Warner Slack, of Beth Israel Hospital and Harvard Medical School in Boston, described his computerized system for taking patients' medical histories. Surprisingly, he said that patients would rather give their histories to a computer than to a live doctor. They find it easier to say "buzz off" to a machine than to a live physician when information is touched upon that they wish to remain private. And the computer is more patient about explaining things and proceeding at the patient's speed.

Dr. Howard Bleich, also of Beth Israel and Harvard, described computer programs to diagnose patients' ailments according to rules of probability, pointing out their ability to help the physician keep up with the enormous medical advances characteristic of today's medicine.

Treating patients by computer was discussed by Dr. Louis C. Shepard of the University of Alabama. He uses a computer to watch patients in a cardiac intensive care unit, and infuse blood when it deems necessary.

But many of the physicians issued this cautionary note: Even though the computer's superior data-handling and record-keeping abilities probably improved medical care, none of the physicians has any hard evidence that patients had benefited. This seemed, however, to be more a matter of further research on the complex questions of the computer's impact on the hospital, rather than a simple lack of effect. — D.M.

\$ACRED MOTHERHOOD



"When women can support themselves, have their entry to all the trades and professions, with a house of their own over their heads and a bank account, they will own their bodies and be dictators in the social realm."

Elizabeth Cady Stanton,
1890

Women have emerged as an integral part of the technological workplace, but misunderstandings over their roles as women and as workers still abound. These problems were brought into focus at the annual meeting of the American Association for the Advancement of Science this winter, stimulated by the designation by the U.N. of 1975 as International Women's Year. Ironically, they discovered some of the same evasions and prejudices that plagued women early in the century, only recast in more liberal terms. (Illustration courtesy of the Schlesinger Library, Radcliffe College.)

Working May Be Hazardous To Your Health

The camel, it is said, will not budge when too heavily burdened, so camel drivers are always forced to meet each animal's own load specifications. People are not so lucky.

Industrial workers must bear a technologically-imposed burden of machines and processes, developed by engineers using a non-human set of values — to manufacture as many things as quickly and cheaply as possible. Unlike the more fortunate camel, industrial workers do not stop working when they are dissatisfied with conditions. True, there are labor unions, but even they must work within the framework of machines as usual. Once a drill press is engineered it cannot be redesigned simply because some

operators keep losing fingers.

Human beings, essentially the most sophisticated and adaptable "machines" in the assembly line, are thus forced to compensate for the deficiencies of the simpler machines made of metal. This "fit the people to the machine" attitude has been highly evident in the development of industrial safety standards, drawing severe criticism from organized labor, women's organizations, and public interest groups.

For example, sewing machine operators, primarily women, are imperiled by the danger of breaking needles flying into their eyes. To prevent this, small plastic eye shields have been attached to the sewing machines for protection. When Peter Nord of the National Institute of Occupational Safety and Health visited one factory, he found that all the shields had been moved aside — the women refused to use them because looking through the poor quality plastic gave them headaches within a couple of hours, he told the A.A.S. in New York this winter.

But the possibility of losing an eye is a minor hazard in comparison to the constant 90 decibel sound level of the machines and the minute threads and dust from the textiles permeating the air the women must breathe all day. Eyestrain, hearing loss, and pulmonary complications are the accepted occupational hazards of this job.

Other speakers at the seminar, "The Occupational Health Status of Women," emphasized the hazards of lead, one of the most dangerous industrial materials. On the basis of medical evidence, lead has been determined to be harmful, if not fatal, to the unborn.

The stop-gap measure offered by the Environmental Health Committee of the Lead Industries Association, said Jeanne Stellman of the Oil, Chemical, and Atomic Workers International Union, was to recommend that the industry not employ fertile women until further research confirms or disproves these allegations. This effectively bars women between the ages of 18 and 55 from employment in

this major industry, Dr. Stellman told the A.A.S., because "all women are assumed pregnant until proven otherwise."

This seems to assume that harm to the unborn is more morally offensive than harm to the mature adult. Even so, setting standards which apply only to the potentially pregnant woman is a master stroke of illogic, for both men and women participate in the reproductive process.

In fact, Andrea Hricko of the Health Research Group in Washington, D.C., reported to the A.A.S. that the children of male as well as female lead workers risk an increased incidence of birth defects. Similar hazards have surfaced in studies of fathers employed as mechanics, as vinyl chloride workers, or those exposed to radiation. One study showed that waste anesthetic gases to which female operating-room personnel are constantly exposed increase the risk of spontaneous miscarriage and congenital abnormalities in their children. But surprising was that an increased birth defect risk was also found among the unexposed wives of male operating-room personnel.

Dr. Stellman fears that the response of the lead industry will become all too common, with many industries refusing to hire specific populations whom they feel to be at greater risk — specifically, all women of child-bearing age. Already the National Council on Radiation Protection has proposed that in order to protect the developing child more stringent standards for occupational exposure be applied to all fertile women, according to Vilma R. Hunt of the Pennsylvania State University.

Economic considerations are the motivating force for such proposals, said Dr. Stellman. It is cheaper to the industry to hire only those for whom the risk is not so obvious than it is to clean up already-established engineering processes and decrease the risk for everyone.

Besides being a near-sighted policy in terms of worker health, such exclusionary standards could be devastating to the employment of women, said Dr. Stellman. Most of the women employed in the U.S. are of child-bearing age. "About 22 per cent of all American households are headed by women and over half of these women work and are the sole source of income for the family," she said. "At least 30 per cent of these jobs can be considered to have potential toxic exposures."

Cora Bagley of the University of Wisconsin offered a way to combat this policy. "Women must recognize that they are dealing with both male-dominated industries and male-dominated government agencies," she said. The way to capture the attention of industrial and governmental regulators is to focus attention on scientific research that proves that toxic effects do not confine themselves to women of child-bearing age. Toxic chemicals and dangerous processes affect everyone.

The Weaker Sex?

An often-heard rejoinder to assertions of men's physical strength is, "Yes, but women live longer."

White women in the U.S. live an average 7.3 years longer than white men, and black women 7.9 years longer, to be exact. But the difference may be a social rather than a biological measurement, Edna Raphael of the Pennsylvania State University told the A.A.S. (*see above*).

The term "the weaker sex" originally described women's high rate of death in childbirth, said Dr. Raphael. Statistically, women in the U.S. earlier in this century lived only a year or two longer than men because of the hazards of the one occupation over which women still have exclusive province — giving birth. The current advantage of women comes from a decreased maternal mortality rate as medical practices and pre-natal care become more sophisticated.

The differences in maternal death rates between white and black women — 1.5 and 5.6 per thousand respectively — are obviously not biological but instead a reflection of social and economic factors, said Dr. Raphael.

Applying the concept of socially-caused life expectancy differences to the workplace, Dr. Raphael theorizes that women live longer than men not because they are stronger, but because they work for fewer years — 25 as opposed to 43 for men — and at less hazardous jobs.

She sees the longer lives of women as demonstrating that occupational hazards, of which bearing children is but one example, can be controlled.

Kinder, Kirche, Küche

As women in developing nations emerge from the home into the world of work over the next few decades, they will choose to have fewer children. This theory, advanced at the recent A.A.S. meeting in New York, directly contradicts the widely-held belief that the population explosion that usually accompanies industrialization is curtailed not by conscious decisions, but by urbanization and increased literacy.

The more popular explanation, called the theory of demographic transition, attempts to explain why birth rates are so slow to match lowered death rates that result from better medical care in developing nations. Numerous population control programs which work to make family planning available are based on this theory. And the theory's acceptance is not a local phenomenon — the majority of the world's nations are expected to establish such programs within the next ten years.

Panel members of the seminar on

economic change and family size roundly thrashed this Mount Everest theory of birth control — that birth control will be used simply because it's there.

"Contrary to the demographic transition theory and Malthus, it is now known that most human populations have regulated fertility to a greater or lesser extent," said Rae Lesser Blumberg of the University of California at San Diego. People are not rabbits, and the baby booms accompanying industrialization are not uncontrolled breedings, but reasoned attempts to maintain stability amidst decaying traditional values.

Dr. Blumberg presents an unsentimental theory: the economic value of children is one reason men and women have them.

Historians have long known that children are desirable as cheap labor and as insurance against poverty in a parent's old age. In newly industrialized countries each additional child represents an additional source of income.

Persian Rugs and Poker Chips

Once a society stabilizes following a period of economic and social upheaval, and once the dividends of industrialization filter down to women, the birth rate drops.

"When people have more attractive and easier ways to spend their time, they tend to choose them." Sociologist Sarene Boocock of the Russell Sage Foundation advocates a Persian Rug theory, in which women who are offered attractive ways of spending time outside the home tend to choose these alternatives, with less regard for child-raising than for themselves. She links lowered birth rates, as women are offered easier, better paying opportunities outside the home, to the demise of exacting, enervating, and low-paying crafts such as Persian rug-making.

According to Dr. Boocock, child raising is difficult work, and "low status is generally accorded to those who care for and educate children. In no society that I have studied has child care ever paid well." Predictably, a 17-nation study by anthropologist Richard Sipes showed an inverse relationship between female status and birth rates.

The World Population Conference in Bucharest last August finally recognized "job satisfaction" in child raising, and made changes in the draft of the U.N.'s World Population Plan of Action that clearly emphasize the role of women in economic, social, and educational development.

More influence for women in society will lead to what Dr. Blumberg calls "poker chips of power" which can be "cashed in for life options," including control over marriage, divorce, movement, and family size. She suggests that "economically-derived power" gives women a "greater voice in the control of their own reproduction." — S.J.N.

Thousands of Rocks and One Pirate

Puzzle Corner
by
Allan J. Gottlieb

Our first yearly problem, Y1975 (see January, p. 62) has evoked some interest and some questions, and a few additional comments are in order. First, I do *not* guarantee that there is a full solution; that is, I do not know that there exists an expression according to the rules of the problem for each integer between 1 and 100. Second, I will follow the suggestion of several readers that if two expressions for the same integer yield the same point value and one uses 1975 in the proper order, that one will be selected. Third, decimal points are *not* allowed. Fourth, the asterisk (*) denotes multiplication (standard in computer programming). Parentheses do not denote multiplication; they are only to be used to indicate the order in which operations are to be performed (that is why they are not assigned any point value). Thus $1 + 9 + (7)(5)$ is illegal and should be written $1 + 9 + 7 * 5$ or $1 + 9 + (7 * 5)$. If parentheses are not used the "normal order of operations" applies: all ** are done first (from right to left), then all * and / (from left to right), and finally all + and - (from left to right).

Since these "few additional comments" have rambled on to such a length, let me simply close this introduction by assuring T. Schaeffer that I am no relation to the pinball magnate who has become rich off his habit; and by reporting that a further solution to O/N1 will appear in June (see February, p. 62).

Problems

MAY1 We start with a bridge problem from Michael Kay. After years of proliferation, these problems are suddenly in short supply.

♠ A J 5 3 2	♦ 10 8	♣ Q 10 9 6	♥ 3 2
			♦ 10 4
			♦ 6 4
			♣ Q J 10 7 4 3 2
			♠ K 4
			♥ A Q 8 6
			♦ A Q J 9 5 2
			♣ 6

South dealt with neither side vulnerable. North-South use Blackwood, and the bidding was:

S	W	N	E
1D	1H	1S	P
3D	P	4D	P
4NT	P	5H	P
6D	P	P	P

You are to use the bidding (and not the East-West hands) to guide you to South's winning play.

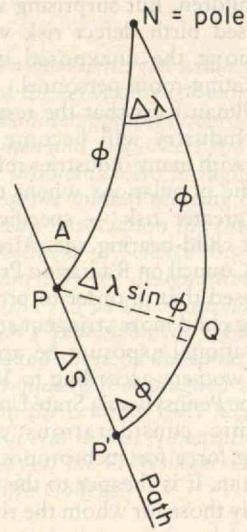
MAY2 Eric Jamin poses the following geometry problem: Given three lengths a , b , and c ($a < b + c$, $b < a + c$, and $c < a + b$), find the side of an equilateral triangle, inside which a point joins the three vertices with distances a , b , and c . (Hint: a geometric solution exists, with only six lines to draw.)

MAY3 Winthrop Leeds wants you to show that for any integer $A > 2$, there exist integers B and C such that $A^2 + B^2 = C^2$.

MAY4 The following problem, entitled "A Rhumb Line Flight," is from R. Robinson Rowe; he describes it as "an exercise in geodesy, on the rhumb line or loxodrome (from the Greek *loxo* meaning 'oblique' and *dromos* meaning 'running' — thus running oblique). As used in navigation, it was very convenient: draw a straight line on a Mercator map from origin to destination and determine a constant azimuth for the entire trip; it isn't much longer than a great-circle course for short voyages or small azimuths and is lots easier to steer." The problem:

— Starting at zero-zero latitude and longitude at 12:00 M on Sunday, Aaron Ott flew his plane at a constant 225 knots loxodromically North 60° West. Where was he at 12:00 M on Monday? Mr. Rowe adds three notes: A ± in the differential equation makes it adaptable to all directions in both hemispheres; here one would use the minus sign because longitude is increasing and colatitude decreasing. A knot is a convenient unit in navigation, being one nautical mile per hour, or one minute of arc per hour; thus 60 knots is one degree per hour and 225 knots is $225/60 = 3.75$ degrees of arc per

hour. The following differential diagram in spherical trigonometry illustrates the derivation of the general differential equation:



In right triangle $PP'Q$:

$$\tan A = PQ/P'Q = (\Delta \lambda \sin \phi)/\Delta \phi = \text{constant}$$
$$\sec A = PP'/P'Q = \Delta S/\Delta \phi.$$

At limit:

$$d\lambda = \tan A \cdot d\phi / \sin \phi$$

$$dS = \sec A \cdot d\phi.$$

MAY5 We close with the following problem from Karl Kadzelski: A band of pirates was chased, and one was caught. A search of the pirate was made, and a description of the location of buried treasure was found; it read: "From the great tree are nine rock formations. Counting from left to right turn around at the ninth rock counting the eighth as ten then again turning around at the first rock counting it as the seventeenth, the second rock the eighteenth, etc. When the number 1,000 is reached, the treasure is buried five paces north of this rock." One of the natives read this description and immediately figured out where the treasure was located without going through all the steps. What formula did he use? And near what rock was the treasure buried?

Speed Department

MAY SD1 Jack Parsons asks:

If eight spades are held by your opponents in bridge (hopefully, spades are not trump), what is the probability of the most probable split?

MAY SD2 John Sowa submitted the following:

You are taking the Graduate Record Examination, a test with multiple-choice questions. The next problem is to evaluate

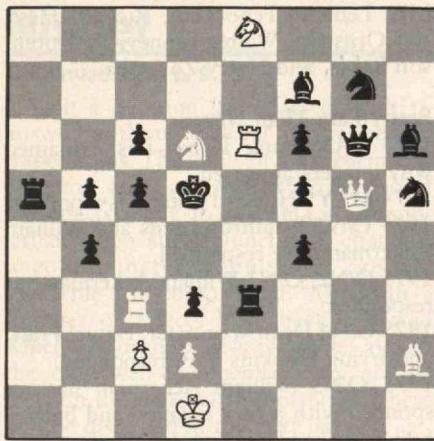
$$\int_0^{\pi} \cos^2 x \, dx$$

You are under severe time pressure. Your mind goes blank, and the only trigonometric identity you remember is $\sin^2 x - \cos^2 x = 1$. But that is all you need! The answer is obvious; without further calculation you select the correct answer. How?

Solutions

The following are solutions to problems published in January:

JAN1 White to play to win:



Although the following (from T. Schaeffer) is not as pretty as some solutions, it is "better" by virtue of using the minimum number of moves, all forced:

- | | | |
|---|------------|--------|
| 1 | N — QB7 ck | K — Q5 |
| 2 | R x P ck | R x R |
| 3 | B — N1 ck | R — K6 |
| 4 | B x R ck | P x B |
| 5 | Q x P ck | B x Q |
| 6 | P x B mate | |

Also solved by H. J. de Garcia, Jr., and son Mark, Richard Hess, Michael Laufer, Winthrop Leeds, Michael Middlebrooke, Ron Moore, Paul Reeves, Frank Rubin, Stephen Strauss, Jerome Taylor, and S. J. Zaroodny.

JAN2 Prove that among triangles of a given perimeter the equilateral has maximal area.

The key is to use the semiperimeter, $s = \text{Perim}/2$. The following is from Avi Ornstein:

Given a triangle with perimeter P , let $P = 2s$. If the sides are expressed as a, b , and c , then the area, A , can be expressed as

$$A = \sqrt{s(s - a)(s - b)(s - c)}$$

If it is an equilateral triangle, $a = b = c$.

Assume, however, that $c = P/3$ but $a \neq b$. Then $a + b = 2c$. In finding A , the difference from an equilateral triangle depends on $(s - a)(s - b)$ compared to $(s - c)(s - c)$; this is equivalent to comparing $s^2 - as - bs + ab$ with $s^2 - 2cs + c^2$, and $s^2 - s(a + b) + ab$ with $s^2 - s(2c) + c^2$. Since $a + b = 2c$, the difference in A can be reduced to comparing ab to c^2 . Since $a + b = 2c$ (again), take a real number x , such that $a = c + x$ and $b = c - x$. Substituting these values into ab , one gets $(c + x)(c - x)$, or $c^2 - x^2$. Whatever the value of x , $ab < c^2$. Thus the triangle with sides a, b , and c has an area smaller than that of the equilateral triangle. What about the case of a triangle abd , where $a + b + d = P$ and none equals c ? Compare this to a triangle efd , where $a + b = e + f$. Let a and e be the larger number in each pair, and let a and b be closer to one another, which means that $a - b$ is less than $e - f$. Then by using a positive number x , $e = a + x$ and $f = b - x$. In comparing areas, the varying factors are $(s - a)(s - b)$ and $(s - e)(s - f)$ which can be expressed as $s^2 - s(a + b) + ab$ and $s^2 - s(e + f) + ef$, respectively. Since $a + b = e + f$, the differences in areas vary by ab and ef . But $ef = (a + x)(b - x) = ab - ax + bx - xx$. Since $a > b$, $ef < ab$. Thus the area of abd is greater than that of efd . This shows that the closer the values of the sides of a triangle, the greater the area for a given perimeter. Hence an equilateral triangle has the maximum size for P .

Also solved by Gerald Blum, Winslow Hartford, Richard Hess, Ken Kahn, Jack Parsons, John Prussing, Paul Reeves, R. Robinson Rowe, Frank Rubin, Les Servi (the proposer), Dave Taenzer, Smith D. Turner, and Harry Zaremba.

JAN3 What is the maximum time a truly parabolic comet can remain inside the earth's orbit?

I wondered why I found this difficult, but now I know! Knowledge of astronomy is helpful; solutions contained references to Lambert's theorem or equations, neither of which is in Gamow's *Matter, Earth and Sky* (my total "astronomical" knowledge). The following is from Richard Hess:

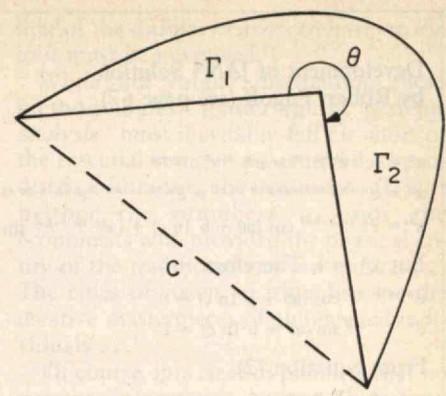
Lambert's theorem gives the time to traverse a parabolic orbit as:

$$t = u^{-1/2} 2^{1/2} [s^{3/2} + (s - c)^{3/2}] / 3 \quad (\theta \geq 180^\circ)$$

$$t = u^{1/2} 2^{1/2} [s^{3/2} - (s - c)^{3/2}] / 3 \quad (\theta \leq 180^\circ)$$

where u is the force constant and $s = (r_1 + r_2 + C)/2$. (See diagram at the top of the following column.)

The time expression is maximum when C



is maximum. For a parabolic orbit within the earth's orbit, $r_1 = r_2 = r$ and for maximum time

$$C = 2r \Rightarrow t_{\max} = u^{-1/2} 2^{1/2} (2r)^{3/2} / 3 = 4r^{3/2} / 3u^{1/2}$$

The period of the earth around the sun is

$$p = 2\pi u^{-1/2} r^{3/2} = 1 \text{ year} \Rightarrow r^{3/2} = 1/2\pi \text{ years} \Rightarrow$$

$$t_{\max} = 2/3\pi \text{ years} \approx 0.212207 \text{ years} \approx 77.5 \text{ days.}$$

Also solved by Winslow Hartford, John Prussing, and R. Robinson Rowe.

JAN4 Find all x such that $x^x = i$.

Another tough one, but at least it's "only" mathematics. The following is courtesy of Robert Pogoff:

x is complex. Therefore, let $x = a + ib = c \cdot e^{i\theta}$ where $c = \sqrt{a^2 + b^2}$ and $\theta = \arctan(b/a)$. Then follows the development in the box on the next page. Thereafter, Mr. Pogoff proceeds: For $m = 0$, first approximations, a_0 and b_0 are made for a and b respectively. Let $a_0 = 1$, $b_0 = 1$. Closer approximations are:

$$a_1 = a_0 - Y_0 / Y'_0$$

$$b_1 = b_0 - Z_0 / Z'_0$$

Substitute these values in equations (12), (13), (14), and (15) to obtain closer approximations:

$$a_{p-1} = a_p - Y_p / Y'_p$$

$$b_{p-1} = b_p - Z_p / Z'_p$$

Continue until differences $|a_{p-1} - a_p|$ and $|b_{p-1} - b_p|$ are small enough. Repeat the procedure for $m = \pm 1, \pm 2, \pm 3, \dots$. Note, also, that by a similar procedure, solutions can be obtained for

$$x^x = -i$$

$$x^x = 1$$

$$x^x = -1$$

where the angle in the right hand side of equations (5), (7), (9), and (14) is respectively, $(4m + 3)\pi/2$, $4m\pi/2 = 2m\pi$, and $(4m + 2)\pi/2 = (2m + 1)\pi$. Finding the solutions to $x^x = \text{any complex unity vec}$

2239	57947	31817	40039	11503	55819	20593	40763
10663	54979	21433	41603	3079	58787	30977	39199
19333	42863	11923	52879	29717	41299	5179	57527
30557	42139	4339	56687	18493	42023	12763	53719
40879	29297	57107	4759	43283	19753	53299	12343
42443	18913	54139	13183	41719	30137	56267	3919
55399	11083	40343	20173	58367	2659	40459	32237
59207	3499	39619	31397	54559	10243	41183	21013

Development of JAN4 Solution by Robert Pogoff (see page 67)

$$x^k = (c \cdot e^{i\theta})^{a+ib} = e^{(ln c + i\theta) \cdot (a+ib)}$$

$$x^k = e^{ia \ln c - b\theta + i(a\theta + b \ln c)} = e^{ia \ln c - b\theta} \cdot e^{i(a\theta + b \ln c)} \quad (1)$$

$$x^k = e^{ia \ln c - b\theta} \cos(a\theta + b \ln c) + i e^{ia \ln c - b\theta} \sin(a\theta + b \ln c) \quad (1)$$

But $x^k = i$. Therefore

$$e^{ia \ln c - b\theta} \cos(a\theta + b \ln c) = 0 \quad (2)$$

$$e^{ia \ln c - b\theta} \sin(a\theta + b \ln c) = 1 \quad (3)$$

From equation (2),

$$\cos(a\theta + b \ln c) = 0$$

$$a\theta + b \ln c = (2n+1)\pi/2 \quad n = 0, \pm 1, \pm 2, \pm 3, \dots \quad (4)$$

$$\sin(a\theta + b \ln c) = \sin[(2n+1)\pi/2] = \pm 1.$$

However, the negative sign does not satisfy equation (3). Therefore n must be even. Let $n = 2m$. Then

$$\sin(a\theta + b \ln c) = \sin[(4m+1)\pi/2] = 1 \quad (5)$$

$$e^{ia \ln c - b\theta} = 1 \quad (6)$$

$$a \ln c - b\theta = 0 \quad (6)$$

and, from equation (4),

$$a\theta + b \ln c = (4m+1)\pi/2. \quad m = 0, \pm 1, \pm 2, \pm 3, \dots \quad (7)$$

Substituting for c and θ , in equations (6) and (7),

$$a \ln(a^2 + b^2)/2 - b \arctan(b/a) = 0 \quad (8)$$

$$a \arctan(b/a) + b \ln(a^2 + b^2)/2 = (4m+1)\pi/2. \quad (9)$$

Solutions to the pair of equations (8) and (9) can be obtained by a version of the Newton-Raphson numerical method. Differentiate (8) with respect to b ; $a' = da/db$:

$$a/2(2aa' + 2b)/(a^2 + b^2) + a' \ln(a^2 + b^2)/2 = (ba - b^2a')/(a^2 + b^2) + \arctan b/a.$$

Therefore,

$$\frac{da}{db} = a' = \frac{-\arctan b/a}{1 - [\ln(a^2 + b^2)]/2} \quad (10)$$

Differentiate (9) with respect to a ; $b' = db/da$:

$$(a^2b' + b^2b')/(a^2 + b^2) + \arctan(b/a) + b' \ln(a^2 + b^2)/2 = 0.$$

Therefore

$$\frac{db}{da} = b' = \frac{-\arctan(b/a)}{1 + \ln(a^2 + b^2)/2} \quad (11)$$

Let

$$Y = a \ln(a^2 + b^2)/2 - b \arctan(b/a); \quad (12)$$

then

$$dY/da = Y' = 1 + \ln(a^2 + b^2)/2 - b' \arctan(b/a).$$

Substituting for b' from (11)

$$Y' = 1 + \ln(a^2 + b^2)/2 - \frac{[\arctan(b/a)]}{1 + \ln(a^2 + b^2)/2}. \quad (13)$$

Let

$$Z = a \arctan(b/a) + b \ln(a^2 + b^2)/2 - (4m+1)\pi/2 \quad (14)$$

$$dZ/db = Z' = 1 + \ln(a^2 + b^2)/2 + a' \arctan(b/a).$$

Substituting for a' from (10),

$$Z' = 1 + \ln(a^2 + b^2)/2 + \frac{[\arctan(b/a)]^2}{1 + \ln(a^2 + b^2)/2} \quad (15)$$

tor is similarly solved by substituting the corresponding angle in those equations.

Mr. Pogoff then lists solutions for a , b , and x^k for values of k ranging from -79

to 121; the list is too long for publication here, but readers may obtain it by writing to the Editors of the *Review* at Room E19-430, M.I.T., Cambridge, Mass., 02139.

Also solved by Gerald Blum, Winslow Hartford, Richard Hess, and R. Robinson Rowe.

JAN5 Can you have a magic square with each entry prime? With each entry a distinct prime?

This one is somewhat of a breather after the last two. Roger Milkman submitted over a dozen solutions; one is

73	349	157
277	193	109
229	37	313

The proposer claims his seven-year-old daughter, after being told the definitions, gave the following solution. Personally, I suspect the only seven-year-olds who could generate such a solution come from I.B.M., etc.; the solution appears in the box at the bottom of this page.

Also solved by Gerald Blum, Loren Dickerson, Emmet Duffy, John Feldman, Mrs. Leonard Fenocetti, Richard Hess, Avi Ornstein, Walter Penney, R. Robinson Rowe, and Harry Zaremba.

Better Late Than Never

1973 J/A3 Frank Rubin has explained why integers appeared.

1974 MAY5 Howard Ostar has responded

1975 O/N1 Winthrop Leeds and William Ackerman have responded.

1975 O/N2, O/N3 William Ackerman has responded.

1975 O/N4 Dean Worcester, Daniel Pratt, and Irving Hopkins have responded.

1975 O/N5 William Ackerman has responded with a very detailed and beautifully organized solution which should be published if space permitted; note that no solution has previously appeared. Copies of Mr. Ackerman's solution can be had from the Editors at Room E19-430, M.I.T., Cambridge, Mass., 02139. (An anonymous reader has also responded.)

DEC1 Responses have come from Emmet Duffy, Joseph Evans, Winslow Hartford, Richard Hess, Fred Price, Ben Roberts, and Stephen Strauss.

DEC2 Responses have come from Emmet Duffy, Winslow Hartford, Richard Hess, Paul Reeves, and Frank Rubin.

DEC3 Responses have come from Michael Goldberg, Winslow Hartford, Richard Hess, Irving Hopkins, Robert Lutton, Robert Pogoff, Paul Reeves, and Frank Rubin.

DEC4 Responses have come from Winslow Hartford, Richard Hess, Craig Presson, and Frank Rubin.

DEC5 Several readers obtained methods requiring more fuel than the printed solution; others used the same method and obtained the same answer. These responses came from Christopher Brooks, Thomas Collins, Gregory Dorner, Emmet Duffy, Richard Hess, Robert Pogoff, Paul Reeves, Frank Rubin, and Stephen

Strauss. Robert Lutton has used a different method and obtained a better result — once more a solution for which there is no space. A copy can be had from the Editors, Room E19-430, M.I.T.

Proposers' Solution to Speed Problems

MAYSD1 Not 4-4 but 5-3, for which the probability is 7/16.

MAY SD2 The curve for $\cos^2 x$ is the same as the curve for $\sin^2 x$ displaced by $\pi/2$. Over the interval $(0, \pi)$, the areas under the two curves are equal. Therefore,

$$\int_0^\pi \cos^2 x \, dx = \frac{1}{2} \int_0^\pi (\sin^2 x + \cos^2 x) \, dx \\ = \frac{1}{2} \int_0^\pi dx = \pi/2.$$

Allan J. Gottlieb studied mathematics at M.I.T. (S.B. 1967) and Brandeis (A.M. 1968, Ph.D. 1973); he is now Assistant Professor of Mathematics at York College of C.U.N.Y. Send problems, solutions, and comments to him at the Department of Mathematics, York College, 150-14 Jamaica Ave., Jamaica, N.Y. 11432.

Nisbet

Continued from p. 9

Such a question is in fact difficult to answer without making subjective extrapolations. The levels of these chemicals in remote areas are relatively low; most of the effects likely to take place are sub-lethal, often subtle functional changes; uncontaminated populations are not available for comparison. Although a number of effects have been reported which are more or less plausible, almost the only well-documented ones are effects on the reproduction of birds. These will be discussed in the next issue.

Ian C. T. Nisbet, who writes regularly for Technology Review, is a member of the Scientific Staff of the Massachusetts Audubon Society. His Ph.D. (in physics) is from Cambridge University.

Boulding

Continued from p. 12

of whether income from pure ownership is or is not a reward for some "function." The really significant problem, however, revolves around the syndromes of centralization and decentralization. If we look upon private property as the price we must pay for decentralization of decision-making — and hence for the relative security of an ecological rather than an organismic system — the whole debate looks very different. One could offer many other examples, and a serious attempt to widen agendas in this debate could hardly fail to be productive.

Kenneth E. Boulding is Professor of Economics and Director of the Institute of Behavioral Science at the University of Colorado.

Book Review

Continued from p. 17

own. But none of these can match the power of the public's collective eye and its visual consensus."

Rolf Jensen in *Cities of Vision*, while agreeing that visual communication is primary, takes the opposite view: "Unfortunately, it is the lot of . . . nearly all planners to be continually confronted with situations in which, in spite of their experience . . . , a lay committee or the public as a whole profess to know better and as frequently insist on pressing their individual and collective points of view against sound advice." And in one of the most interesting criticisms of Lewis Mumford on record, referring to some Mumford Senate testimony: "He claimed that he saw his vital role as one of knocking heads of specialists together, and taking a lofty overall view of their activities which they were incapable of doing themselves. Coming from a layman who does not appear ever to have been involved professionally in city planning, this damaging and presumptuous assertion seems to stem from what might have been hoped was the long-dead fallacy of equating specialization with narrowness. The statement was made, as might be expected, without any suggestion of evidence to support the belief that the trained professional expert was a fool who needed to be taught his business by the bystander."

People versus Professionals

Thus, one of the major (largely unspoken) issues in today's urban planning scene is confronted by two very able, experienced, and articulate men. Mr. Clay is a respected urban journalist, editor of *Landscape Architecture Quarterly*, formerly real estate editor of the *Louisville Courier-Journal* and President of the American Society of Planning Officials. Professor Jensen has had 40 years of varied experience in architecture and planning in Britain, Southeast Asia, and Australia; he is Dean of the Faculty of Architecture and Town Planning at the University of Adelaide. *Close-Up* deals with observations and trends, developing new, more accessible phrases for established urban design terms. *Cities of Vision* is a more conceptual and historical presentation, devoted to more professional concerns.

Clay and Jensen are both critical of computerized systems and systems analysis. Clay supports Harvard Professor Alan F. Westin's conclusion that "access to expensive computer systems . . . has turned into 'a factor in consolidating rather than in redistributing government power,' and that access to this new source of power remains so expensive that 'the poor, the black . . . cannot harness computers to their causes.' The gap between the power of experts to manage data and

that of the ordinary citizen to have access to it must be narrowed."

While not totally discounting these methodologies, Jensen thinks systems analysis "must inevitably fall far short of the essential creative act required to produce a humane environment. It was neither the plumbers . . . nor the economists who provided the physical entity of the traditional city we admire. . . . The cities of vision . . . thus become the creative masterpieces of enlightened individuals . . ."

Of course, it is clear to planners that no present information system has been adequately coupled with an enlightened individual and/or a citizen-interaction process at the city level over a significant period of time. Certainly there is potential here requiring strong governmental leadership and sustenance.

A compromise is perhaps our best course: it is desirable that urban visual values for use in design should transcend, but not ignore, the common denominator of any present transitory population. Human and other resources will be protected if city designers value the *wants* of their contemporaries, the *needs* for their social development, and the *goals* for achieving the best possible society in the future.

"Wants" refers to the routine expressions of individual desire by citizens who have not been exposed to a significant range of options. "Needs" are those things that can be determined through a systematic application of current facts and evaluation systems. "Goals," inherently dealing with values, must be imaginatively developed and constantly and explicitly referenced to the most desirable facets of a changing society.

Clearly, *Close-Up* is devoted to retrieval of and concern for the wants of the current population, and *Cities of Vision* is most substantially concerned with needs and goals. Twentieth-century urban planning has given most weight to our needs, with oscillations toward goals in the first quarter and toward wants in the last. Environmental protection and energy conservation are major forces currently swinging the pendulum again toward goals. The peruser of these books will find himself asking many questions: the relative weights of current needs of individuals, needs of society in general, and goals for future developments; the appropriateness of the valuations given these in past and current decisionmaking processes; and the needs for improvement in the immediate future.

Ralph Warburton is Professor and Chairman of the Department of Architecture, Architectural Engineering, and Planning at the University of Miami, Coral Gables, Florida. He studied architecture at M.I.T. with the Class of 1957.

An Institute Informant

The Editors' digest of recent and current concerns at the Massachusetts Institute of Technology

A New Senior Program in Health Management

Next month a new set of pioneers in health care management will cross the threshold of the Sloan School of Management, just 40 years after members of the nation's first executive development program came to M.I.T. Like their predecessors, who are now known as Sloan Fellows, members of the Sloan Fellowship Program, the new health management executives will study for 12 months in the Sloan School, completing the advanced program with master's degrees in June, 1976.

The idea, says Edward B. Roberts, Sarnoff Professor of Management who will be in charge of the program, is to give health management executives an education in general management — they'll share many activities with the Sloan Fellows — while they take special courses to help them with the "unique managerial aspects of health care delivery, education, and research."

These special courses will include planning and control in the public sector, management sciences in health, managing change in health organizations, health economics, and a seminar in health management.

It will be what Professor Roberts calls "a comprehensive educational program on managerial applications of economics, psychology, and quantitative analysis, studied in the relation to general management as well as to health-specific issues." The students are planned to be "mid-career health care practitioners, educators, and research and administrative people" who want to prepare for "continued career growth and increased responsibilities in the health field."

In a pilot for the new program, some 80 medical school deans and faculty from over 40 medical schools have during the past two years attended sessions of the Association of American Medical Colleges' Management Advancement Program at the Sloan School. The core faculty for these sessions, and for the new health management program, in addition to Professor Roberts, are Richard Beckhart and

John F. Rockart, Senior Lecturers at the Sloan School. Further information and applications are available from Peter P. Gil, Associate Dean for Teaching Programs, at the Sloan School of Management, 50 Memorial Drive, Cambridge, Mass., 02139.

What Federal Role in Automotive Research?

Two decades ago the notion that research on automobile design and engineering could be a responsibility of the federal government — instead of or in addition to that of industry — would have been repugnant — perhaps unthinkable — to industry, government, and taxpayers alike.

But today the public's stake in improving air quality and reducing energy consumption is so broad that research and development on alternative power systems by the federal government is justified, even essential.

That conclusion in a report of the M.I.T. Energy Laboratory prepared by Professor John B. Heywood (mechanical engineering), Professor Henry D. Jacoby (economics), and Lawrence H. Linden (mechanical engineering) late last year.

"The incentives to the automobile manufacturers are not sufficient to cause them to perform all the alternative power-plant research and development which can be justified on the basis of potential social benefits from reduction in emissions," says the report. "Though the incentives and national goals are less clear in the area of fuel economy, there may be a divergence here as well."

Examples where federal programs might "significantly add to reduction of technological uncertainty or provide important public information":

— Studies on a light-weight diesel engine to define the lower bounds of emissions and the trade-offs between these attributes and fuel economy. With "technological and regulatory uncertainty reduced," the benefits of further research to industry would more nearly coincide with those to society as a whole and industry could be expected to proceed.

— Research on the critical problem — a suitably inexpensive heater design — for the Stirling engine.

— Work on the use of ceramic components in automotive gas turbines.

— Developing information on alternative power plants to the extent necessary for policy development (because the proprietary interests of industry conflict with the disclosure of some needed data).

The price tag might be \$15 to \$35 million a year — a substantial increase over the existing Advanced Automotive Power Systems Program at \$7.5 million annually.

Flashing Brake Light

A flashing automobile brake light, the frequency of whose flashes corresponds to the rate of deceleration?

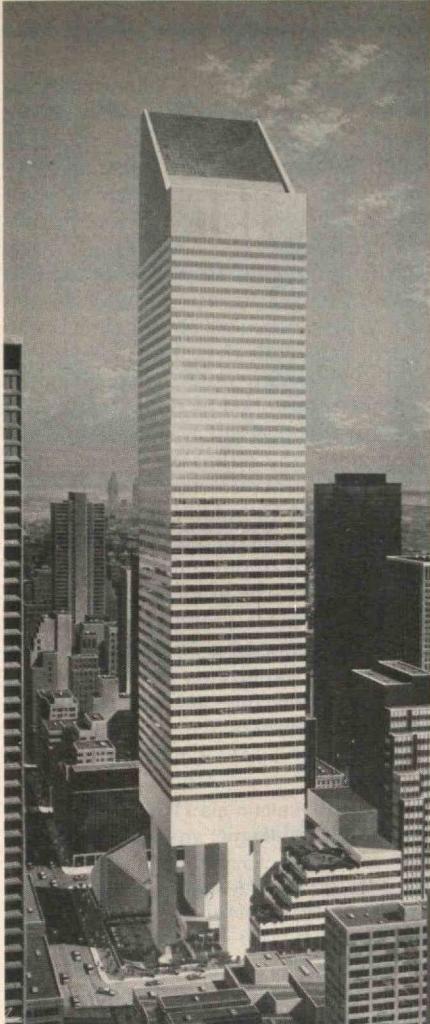
Renwick E. Curry, Associate Professor of Aeronautics and Astronautics, has patented a device with just this result, and his students are building a prototype this spring. The idea is to give motorists a special warning — a rapidly flashing light — of panic situations and a very different warning in more normal ones.

Professor Curry thinks the flasher — about the size of a cigarette pack — could be mass produced for less than \$10. A similar concept, but involving a separate flashing light instead of the standard brake-light system, is said to have been successfully tested by a California inventor in San Francisco; but there are no plans for controlled experiments to confirm the usefulness of Professor Curry's invention.

Solar Energy for Air Conditioning?

Can a solar collector mounted atop a New York skyscraper reduce the conventional energy needed to air condition the building?

Leon R. Glicksman, Lecturer in the Department of Mechanical Engineering, thinks so; and now the M.I.T. Energy Laboratory will have a chance to prove it in a detailed engineering analysis of a sys-



A glimpse of the future? M.I.T. Energy Laboratory engineers are now studying how to use solar energy to dehumidify air to be circulated in the top half of the new Citicorp Center in Manhattan. If the system seems feasible, it may save 5 per cent of the energy which otherwise would be devoted to air conditioning. Some 20,000 ft.² of solar collectors — almost half an acre — will be mounted on the roof.

tem which might be used for the Citicorp Center, a 56-story office building now being built at Lexington Avenue and 53rd Street in Manhattan.

A conventional air conditioning system dehumidifies air by chilling it, then uses fuel to restore heat to the air before it is provided to building occupants. Dr. Glicksman proposes a substitute for this "reheat" system: Dehumidify the air by passing it through a spray of water-absorbing liquid, then cool it only as much as necessary for the occupants' comfort. The solar energy would be used to dry the water-absorbing liquid which could then be recirculated and redried.

Dr. Glicksman thinks the solar system might provide energy for dehumidifying the top half (25 floors) of the building and

save up to 5 or 10 per cent of the energy otherwise needed for air conditioning. If his analysis of the system (to be sponsored during 1975 by the National Science Foundation) confirms that estimate, he and his associates will proceed to develop an operating plan.

In the proposal for the project, the M.I.T. Energy Laboratory said it "offers a timely and unique opportunity to perform a critical experiment on the economic utilization of solar energy."

Research Notes: New Projects in M.I.T. Laboratories

Housing as a Total Problem

Can techniques of the off-site mobile home industry and the on-site custom builder be brought together to improve performance of the housing industry? An answer will come from Arthur D. Bernhardt, Assistant Professor of Architecture, who has just finished the first stage of an extensive, long-term program: an analysis of the mobile home industry, including land use controls, taxation, building code regulation, financing, and materials. Why mobile homes first? Because that industry has demonstrated cost, production, and delivery efficiencies; but it is still lacking responsiveness to user needs, architectural excellence, and societal needs.

Roads for East Africa

What kind of roads should be built in Ethiopia, Kenya, Tanzania, and Malawi? And who should build them? Questions to be resolved during a three-year, \$400,000 study by the M.I.T. Department of Civil Engineering for the U.S. Agency for International Development. At the moment 70 per cent of the population of Ethiopia live more than 100 km. from a road, and the study will begin on that country's problems. Fred Moavenzadeh, Professor of Civil Engineering who has been involved in research on road transportation in developing countries for the last five years, is in charge of the project.

Equipping an X-Ray-Seeking Satellite

The payload for the third Small Astronomy Satellite, SAS-C, which will be launched this spring in East Africa has been completed in the M.I.T. Center for Space Research. The goal will be to seek and precisely locate sources of x-ray radiation in space, and the M.I.T.-designed experiment is expected to do this five or ten times more precisely than has done before — to 10 or 20 arc seconds.

The payload forms the entire upper half of the SAS-C, and its construction represents an unusual undertaking for an academic laboratory — "one of the largest and most difficult projects we've ever done," says Richard Taylor, Project Manager for the \$8 million, five-year job.

Power Transmission by Cryocables

Vacuum-insulated underground power cables cooled to liquid nitrogen temperatures seem to M.I.T. engineers a practical alternative to overhead power distribution systems in suburban areas. Standard underground cables are five to 20 times more costly than overhead lines, but "cryocables" may be only twice as costly; they are less expensive to build than conventional underground cables and are apparently more resistant to damage.

The cryocable being studied at M.I.T. consists of an aluminum pipe containing three aluminum conductors which are themselves pipes through which is pumped liquid nitrogen. The conducting pipes are separated from the exterior piping by ceramic spacers, and refrigerators and pumps located every 1.5 miles or so cool and circulate the liquid nitrogen.

The Connections Between Food and Brain

A three-year grant of \$176,132 from the John A. Hartford Foundation will cover biochemical research relating the constituents of diet to variations in brain function, responses of the body to drugs, and possibly even to behavior. The studies are by Dr. Richard J. Wurtman, Professor of Endocrinology and Metabolism in the Department of Nutrition and Food Science.

Employee Training and Upgrading

How well are state-operated programs for training unemployed and underemployed workers really serving the needs of Eastern Massachusetts? To answer the question, the Manpower Administration of the U.S. Department of Labor has commissioned a \$270,000 study by the Industrial Relations Section of the Sloan School of Management.

The point is to compare existing programs, funded under "revenue sharing" and directed and operated at state and local levels, with their predecessors which were funded and operated under federal guidelines.

Cable Television in Education

M.I.T. will become a laboratory for the use of television in college-level classrooms and laboratories under a \$620,000 grant from the Alfred P. Sloan Foundation, Inc. The goal will be to create an educational television network on the campus, develop pilot programs for classroom use of its content, and evaluate the results. In prospect, after two-way television channels have been brought to critical areas of the campus and appropriate production facilities completed: a drama course by the Department of Humanities, studies of news videotapes by the Department of Political Science, and pilot programs for using videotape material to teach biology and management.

Classified

PUBLICATIONS

HOW TO EARN MONEY AS A CONSULTANT: \$14 (including specimen contracts) Business Psychology International, 342 Westminster Avenue, Suite 228/13, Elizabeth, New Jersey, 07208

GUIDE TO STATE REGISTRATION
of Professional Engineers, \$5.95 from P. E. Guide, Box 1897, Rockville, MD 20850

MONOPOLY If you played "Monopoly" in the 1920's or earlier, please get in touch with Professor Ralph Anspach, 1060 Keith Avenue, Berkeley, Calif. 94708 (or call collect 415-525-7744). I am researching the game's true origin.

"THERMODYNAMICS" BY N. A. GOKCEN (MIT '51)

Head, Chemical Thermodynamics Section, Aerospace Corporation, El Segundo, CA. A textbook for graduate-senior level course emphasizing mathematical rigor and numerical application; 400 pages, \$24.90. Prepublication offer until May, 1975, \$19.90. Techscience, Inc., P.O. Box 1100, Hawthorne, CA 90250

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Letters

Continued from p. 7

1975 dollars an LWR would cost \$400 to \$600/KW.e. in inflated dollars for a 1982 startup. However, society as a whole would be willing to pay a greater premium. The "broad" margin here is about \$850/KW.e., which is nearly twice the admissible margin as perceived by individual electric utilities and is over twice the cost of an LWR. The breeder program is thus seen to be economically more attractive to society as a whole than it would be to the total of all electric utilities taken singly.

While projections of the extent of our low-cost uranium resources are subject to uncertainty, the estimates we have used may indeed prove correct. If breeders are to be effective in holding down our consumption of uranium, they must represent a sizeable part of our nuclear capacity by the year 2000. The prudent course now is to look for more uranium while at the same time continuing development of the breeder on a top-priority basis. As matters now stand we may need to succeed in both these ventures.

T. R. Stauffer
R. Palmer
H. Wyckoff
Cambridge, Mass.

Mr. Stauffer is at Harvard University, Mr. Palmer with General Electric Co., and Mr. Wyckoff with Commonwealth Edison Co.—Ed.

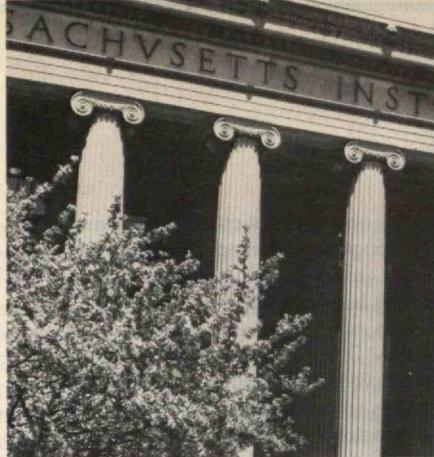
Technology vs. Reality?

"Technological Change in the Food Industry" (December, 1974, pp. 20-29) seems to be somewhat out of touch with reality. In these times of energy shortages (and with a future promising more of the same), inflation, and high unemployment levels, the application of a technology which increases use of energy and capital-intensive, labor-saving devices and methods is surely not a plausible solution.

That current methods of commercial food production and distribution are not completely efficient is unquestionable. However, technological advances must be within the context of agricultural decentralization and the reality of today and tomorrow. As energy prices soar, reflecting true social and environmental costs, it will become feasible to once again till local soil rather than rely on goods trucked half way across the country. Rural employment opportunities will increase, slowing the rural-to-urban migration. As artificial fertilizers become scarce, the rich sludge from our heretofore-wasted sewage will be utilized.

Obviously, technology has a large and important role to play in food production and distribution. But only if it is applied within the above framework will it be of benefit to our needs.

John Merriman, Jr.
Rochester, N.Y.



Institute Review

In This Section

A renewed effort to understand and demonstrate the potential of technology for society sparks a \$225 million Leadership Campaign: a six-page report on an heroic, five-year program for M.I.T. (pages 73-77).

The Institute will train nuclear engineers for the Atomic Energy Organization of Iran (page 78) . . . but a lively debate displays the many dimensions of such a commitment (page 79).

Everything's up: the budget rises, and the Freshman Class of 1979 will be the largest in history (page 80).

The successes and problems of fraternities (page 81) brought to life by Jim Gust of Sigma Nu (page 82).

As the Bicentennial begins, M.I.T. prepares for an uncertain deluge (page 85).

"A modern miracle of recycling" gives M.I.T. a new focus for research on cancer (page 87).

Two students tell why they write: It is "fundamental to the way I perceive myself and my life," says Chris Dippel (page 90).

Winter sports report: the fencers were number one, and our 340-lb. wrestler was a strong number two (page 94).

New heads for Humanities and the Libraries (page 96); "in some ways in the future the only way you'll be able to do good science or technology is by having a very keen awareness of the humanistic and social science component," says Professor Mazlisch (page 97).

A question for John Dean: "How could you be so stupid . . . ?" (page 98).

A \$225 Million Campaign for M.I.T. to Ensure Technological Leadership for a Complex Society

In a world beset by technological complexities and yet increasingly dependent on new scientific and engineering achievements and their wise use, M.I.T. is "poised for new leadership," says President Jerome B. Wiesner. It is to realize that opportunity, Dr. Wiesner told members of the Alumni Advisory Council in a historic meeting on April 22, that the Institute would two days later announce a two-phase M.I.T. Leadership Campaign to raise \$225 million in private support.

The initial goal is \$125 million over the next three years; another \$100 million is included in a second phase during the following two years.

Of the \$225 million, \$100 million is to be added to the Institute's permanent endowment funds. The book value of those funds stood at just over \$333 million on July 1, 1974; the \$100 million would represent an increase of more than 30 per cent.

Another \$43.2 million is needed for specific teaching, research, and service programs — energy research and development, research and teaching in the health sciences, work in the creative and performing arts, studies of transportation systems, educational developments, and improvement and extension of the M.I.T. library system.

The Leadership Campaign includes \$61.8 million for new facilities — two undergraduate houses, an athletics and special events center, and improved teaching, activity, and fraternity facilities. Unrestricted funds totalling \$20 million are included to assure flexibility in future financing.

A total of \$43 million has already been committed toward the \$225 million goal, and all gifts, grants, and bequests received during the five-year campaign period will be applied to the Leadership Campaign objectives.

Complex Technology for a Complex Era
President Wiesner told the Alumni Advisory Council that the task of preparing for the

Leadership Campaign — he thinks the Campaign itself will be "probably the hardest job we've ever tackled," — had been an "exhilarating one" which had brought him "a new understanding of our opportunities and achievements."

William Barton Rogers' vision for "an institution to meld science and the useful arts" may have related to a world very different from today's, Dr. Wiesner said, but the needs are different only in scale. Today the necessity to understand new science and technology, and fully to comprehend how these disciplines can help solve social problems, is made more urgent by the scale and complexity of our problems and of our possible solutions.

"Simply put," writes Dr. Wiesner in a document prepared for a Campaign publication, "the task is to learn to manage a complex industrial society, to allocate and use our technological and social capabilities in a constructive and responsible manner. It is a task in which no modern state — democratic, communist, or fascist — has thus far been successful. For us the difficulty will be greatest, for our need is to make more responsive, equitable, and subtle the most effective, humane, and productive society that has ever existed."

Urgent Need for Leadership

Why now? Howard W. Johnson, Chairman of the M.I.T. Corporation, was asked at the Alumni Advisory Council meeting. Because the need is now, he replied: "Whether or not we succeed will determine the extent, quality, and continuity of M.I.T.'s future contribution" to national and world needs. Noting competition from scores of other university fund drives, Victor K. McElheny of the *New York Times* asked Mr. Johnson a similar question at a press conference in New York on April 23. Mr. Johnson replied by turning to his experience in retailing: stores look for sites "with the stiffest competition because that attracts the customers."

"Our decision to move now to seek this

The Campaign for Leadership

Following is a statement by Howard W. Johnson, Chairman of the Corporation; Jerome B. Wiesner, President; and Paul E. Gray, Chancellor, released on April 24 at the announcement in New York City of the \$225 million M.I.T. Leadership Campaign.

In the United States and around the world, the Massachusetts Institute of Technology stands as a symbol of science in the service of mankind and the strengthening of our society. People everywhere look to M.I.T. to contribute basic knowledge and to demonstrate its usefulness — and to provide education, wisdom, and inspiration for a future that depends upon the development and wise use of a new technology.

Men have always dreamed of a just world free of fear, disease, and hunger in which all could reach for their highest aspirations. The emergence of modern technology first gave us the power to achieve that vision and the hope of realizing it. As a result we have turned to our use a remarkable range of materials from the environment in which we live; we have a high standard of living; we have developed an economic system to spur technical and social development;

we have begun to insure protection of the environment; and we have made major commitments to social justice and welfare.

But we live today in a world of increasing scarcity, complexity, and change. We are aware of serious new problems created in our efforts to solve old ones, and some of these appear to be harder to understand and more convoluted than those they displace. So it is that many people feel adrift, caught up in a system which emphasizes material goods beyond humanism yet fearing that even today's standards of life cannot be brought more equitably to all people, perhaps even sustained for us as we now know them. Everything seems related to everything else in a web of such complexity as to defy our understanding and management. We are puzzled about next steps, and while we ponder them we seem to find ourselves surrounded by constraints and complications that sap much of our momentum and self-confidence and personal freedom of action.

But the fact remains that today's problems are the consequences of our earlier successes and accomplishments. A visit to a less developed country quickly con-

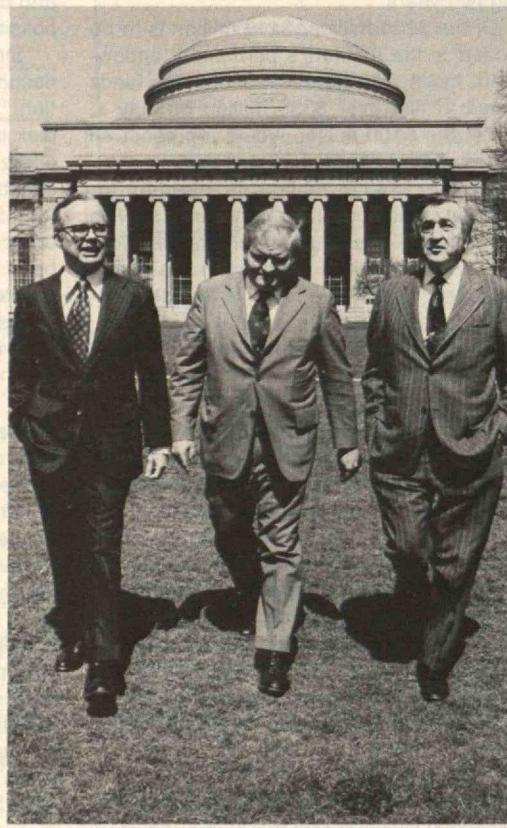
vinces one that solutions must be found not through abandoning a technological society, but through improving it and learning better to manage it.

There remain to us vast natural resources, boundless human energies, and endless prospects of new technologies with which to approach the future hopefully. There can still be a quantum increase in our understanding of the world in which we live and in the wisdom and effectiveness with which we manage our affairs and use our many resources. There are before us enormous opportunities to make each person's life a more rewarding experience, spiritually and culturally as well as materially.

We need wisdom, leadership, and understanding marshalled purposefully for the issues before us. Trained minds are needed to identify public issues and frame them in new ways so that their true dimensions become apparent. New perspectives can, on occasion, lead to collaboration in areas that have been battlegrounds. The requirement that scientists, humanists, and scholars in the socio-technical, economic, and political fields help define present and future problems has been intensified.

Men and women in universities bear a heavy responsibility to enable our institutions to evolve and to cope with the contemporary problems. Their goal must be to guide social forces to avoid collisions without, at the same time, creating a monolithic structure to absorb the population to the detriment, if not the death, of individualism and initiative. This is the challenge to the western world in the final decades of this century. It is a challenge to which modern universities — leadership institutions with teachers of superlative, broad, and timely understanding — are among our invaluable resources, and on any list of these the Massachusetts Institute of Technology must have a very special place.

Through the creative genius of such outstanding leaders and scholars as William Barton Rogers, Francis Amasa Walker, Arthur Amos Noyes, Richard Cockburn Maclaurin, Karl Taylor Compton, Samuel Cate Prescott, Norbert Wiener, Vannevar Bush, Warren K. Lewis, Julius Adams Stratton, and James Rhyne Killian, Jr., the foundations were laid in M.I.T.'s first 100 years for the superbly broad understanding of the sciences and their applications to the full range of human interests and concerns which now characterize the institution. Interdisciplinary cooperation has



These are the leaders of what President Jerome B. Wiesner (right) calls "truly the symbol of science in the service of mankind." With him are Howard W. Johnson (left), Chairman of the Corporation, and Paul E. Gray, '54, Chancellor.

"Countless people instinctively look to M.I.T.," President Wiesner told the Corporation Development Committee last winter, "for inspiration and leadership toward a future which they expect will be enormously influenced by technology.

This is our trust, too," he said. (Photo: Ivan Massar from Black Star)

been a notable characteristic of M.I.T.'s strength in this first century of service.

Today the Institute's teaching and research programs reach out to people, industries, and institutions in more than 120 countries. They comprehend with unique power many important areas of greatest concern — energy supplies, health, industrial productivity, housing, economics, materials, communications, food and nutrition, political science, resources, environmental protection, and planning. These are complemented with great strengths in the sciences, the arts, and the humanities. Together these offer unique leverage on some special contemporary issues: assessing the impact of technology, improving the skill with which social and industrial organizations are managed, enhancing international security and understanding, bringing the arts and humanities into a more productive relationship with science and engineering, insuring freedom and privacy — enhancing in all ways the roles and lives of all people in technological societies.

But to appropriately scale M.I.T.'s contributions to the needs and opportunities of today and tomorrow requires new and unprecedented resources — major new funds to assure excellent faculty and outstanding students, funds to support major experiments in crucial fields and to provide a limited number of critically-needed core facilities. The M.I.T. Leadership Campaign has been carefully planned to underwrite and extend the quality and strength of vital programs. It is based on the belief that our present problems — serious, complex, and even discouraging as they sometimes seem — are in fact unprecedented opportunities for innovative individuals and institutions. It is our conviction that there can be major advances in the human condition, and that the best ingredients for the future remain those that have brought us so far in the past — free human beings and innovative private institutions, both industrial and academic, functioning in democratic societies with responsive governments.

At its Bicentennial, America properly looks to M.I.T. to lead in the future as it has in the past. We can do far more than we have done to improve people's lives. We can make major advances in health, education, and well-being, here and now, in our own time. This is our goal as the Institute looks to its Leadership Campaign for major new private resources. We are determined that M.I.T. shall succeed.

new support, Mr. Johnson said in an earlier statement, "is based both on our belief in the fundamental strength of the American economy and on the realization that now is the time that the kind of technological leadership M.I.T. can offer is most urgently needed."

Paul F. Hellmuth, '47, Managing Partner in the Boston law firm of Hale and Dorr who will be Co-Chairman of the Leadership Campaign with Mr. Johnson, agreed: "We have so many enemies — famine, war, disease, inflation, to cite a few," he told the Alumni Advisory Council, "that no one knows how to coalesce the resources of the country to fight them."

"This is precisely where the talents that have been assembled at M.I.T. over a long period of time — and where further talents that can be assembled at M.I.T.'s resources for leadership are expanded through this campaign — can and should make a major impact."

Making Endowment Keep Pace

Though the financial goals of its Leadership Campaign are large — only four American universities currently seeking capital funds have set higher targets — M.I.T.'s financial position is strong, says Paul E. Gray, '54, Chancellor. It is true that costs have been rising at a rate much faster than the increase of income from all regular sources in the 1970s; but shortfalls have been covered with contingency reserve funds set aside in

the 1960s.

"We have not to the present had to retire any of the university's invested endowment in order to balance the annual budget," according to Dr. Gray's statement to the Alumni Advisory Council.

Since 1963 tuition, gifts, and research income to M.I.T. have grown roughly apace with the Institute's educational and general expenses. But the Institute's endowment "has not been growing at a rate which equals the rate of growth of expenses," Dr. Gray reported; and "investment income used in operations has fallen as a fraction of total expenses" since 1970.

Hence the emphasis in the Leadership Campaign goals on endowment for professorships, student financial aid, research and innovation, and general purposes.

James R. Killian, '26, Honorary Chairman of the M.I.T. Corporation, notes that the Institute now has \$55,000 of endowment funds per student — an amount, he says, that is "well below" the range of \$79,000 to \$98,000 of endowment per student that prevails at "most of America's leading colleges and universities."

"An Aristocracy of Those Who Care"

The Leadership Campaign is the third major capital fund effort of M.I.T. since World War II. The first was established in 1950 by a Committee on Financing Development, which sought \$20 million primarily for improving faculty salaries. Ten years later



This historic photograph of M.I.T.'s leadership was made on April 22 as Howard W. Johnson, Chairman of the Corporation, announced the Institute's plans for a \$225 million, five-year Leadership Campaign. Left to right: (seated) James R. Killian, Jr., '26, Honorary Chairman of the Corporation; Julius A.

Stratton, '23, President Emeritus; Jerome B. Wiesner, President; Mr. Johnson; (standing) Walter A. Rosenblith, Provost; Paul E. Gray, '54, Chancellor; Luis A. Ferre, '24, President of the Alumni Association; and Paul F. Hellmuth, '47, Co-Chairman of the Leadership Campaign.

Five-Year Goals of the M.I.T. Leadership Campaign

Following is a summary of the five-year objectives of the M.I.T. Leadership Campaign for \$225 million

vide new capital for the Technology Loan Fund, the oldest, largest, and most successful private collegiate loan fund in the country. There is an urgent need for a substantial increase in endowed fellowships and scholarships and for a number of special high-leverage funds to subsidize high-interest student loans.

Research and Innovation Funds \$20.0 million

Endowment funds for research and innovation have special value because they make possible modest support to advance new research areas and to experiment with new teaching techniques during their early stages. Such support serves as a kind of "intellectual venture capital" without which many innovative ideas and projects would remain unexplored. The value of such funds has been demonstrated at M.I.T. by the Sloan Fund for Basic Research in the Physical Sciences; now the need is to extend this type of support to include many other departments and interdisciplinary activities.

General Endowment \$20.0 million

M.I.T. depends upon its endowment to maintain its independence, to provide additional sources of intellectual venture capital, to underwrite the actual costs of education covered only in part by tuition, and — because it provides an assured source of revenue — to help provide financial security. The Institute seeks a significant increase in its general and unrestricted endowment funds to meet these needs, a space renewal and modernization fund to use throughout M.I.T., and special purpose funds for the use of M.I.T.'s academic departments.

Endowment

A total of \$100 million to be added to the Institute's permanent funds:

Distinguished Professorships and Career Development Support for Younger Faculty

\$50.0 million

Adequate faculty endowment continues to be one of M.I.T.'s greatest needs: for a faculty of more than 900 (including more than 300 members of the National Academy of Sciences, the National Academy of Engineering, the National Institute of Medicine, and the American Academy of Arts and Sciences), M.I.T. has only 60 endowed professorships. Additional chairs for distinguished scholars are urgently sought; so are other endowed chairs which will provide recognition and encouragement to younger faculty during the earlier years of their professional careers. Also sought are funds that will provide for important visiting professorships and lectureships.

Funds for Student Loans, Scholarships, and Special Loan Subsidies

\$10.0 million

Educational costs continue to rise. If an M.I.T. education is to remain within the reach of all who are qualified and willing to invest in their future, the Institute must find substantial new resources for student aid. The funds sought would pro-

vide new capital for the Technology Loan Fund, the oldest, largest, and most successful private collegiate loan fund in the country. There is an urgent need for a substantial increase in endowed fellowships and scholarships and for a number of special high-leverage funds to subsidize high-interest student loans.

interest at M.I.T.; about 12 per cent of the Institute's graduating seniors, for example, now go on to medical school. Much of this effort is focused in the Harvard-M.I.T. Program in Health Sciences and Technology, a major collaborative effort to train new kinds of health professionals — physicians who understand science and engineering and engineers with a knowledge of human biology who can bring engineering to health needs — and to carry out research and development on major medical and health problems. Expendable research and teaching funds and student aid are urgently needed to sustain the program's promising beginning.

Division for Study and Research in Education \$2.5 million

How do people — and organizations — learn? And what characteristics distinguish learning in quantitative fields such as science and engineering? These are among the questions that motivate the new Division for Study and Research in Education, which seeks to bring about a new kind of education research by drawing on the resources of faculty, visiting lecturers, and graduate students together with those of educators who are working with children and adults in experimental and traditional learning environments. The work of the Division will affect education at M.I.T. and the process and philosophy of education in general, including the development of new technology to aid the learning process. Faculty, student, and general support are needed.

Creative and Performing Arts \$1.2 million

M.I.T. views the arts not as "enrichment" of the scientific and technological curriculum but as active disciplines in their own right, to be integrated in a truly modern education for the contemporary age. The goal is to provide students with working experiences in the arts and to involve them in esthetic choices and formal statements of value. M.I.T. now has a wide range of programs and activities in the arts that is stimulating strong interest and participation throughout the campus. The need is for expendable funds of teaching, research, and student projects.

Library System Development \$8.0 million

The M.I.T. Libraries are caught between demands for growth — the proliferation of human knowledge, the rising cost of publications, the increasing needs of increasing numbers of students and faculty — and limited financial resources. The M.I.T. Leadership Campaign seeks special funding for an automated library system including computer linkages to other important libraries in the nation and to regional and national bibliographical data bases (\$4.5 million); strengthened collections to meet the needs of new interdisciplinary programs

New Program Support

A total of \$43.2 million in expendable funds for new programs:

Energy Laboratory \$7.5 million

Recognizing once again its responsibility to work for solutions to complex public problems, M.I.T. in 1972 made a major commitment to research in the field of energy through the establishment of a special Energy Laboratory. The Laboratory brings together activities at the Institute to deal effectively with the complex technical, economic, and social problems of energy production and use. Already its interdisciplinary program of research is at a level exceeding \$3.5 million annually. A large infusion of discretionary capital is now essential to support the effective growth of the Laboratory during its critical formative years.

Health Sciences \$2.0 million

Problems of health and health care and of health sciences teaching and research are attracting greatly increased

in such fields as transportation, health sciences, and the history of art and architecture (\$1.5 million); and funds for new collections in the history of science and technology and in the study of technological society (\$1 million each).

Continuing Education

\$2.0 million

Rapid change is a characteristic of modern society; reason enough, therefore, to expect people to change, too. Professionals — especially architects, engineers, planners, managers, and others working in fields of applied social science — frequently find their fields "moving out from under them." An institution at the forefront of change is ideally situated to help professionals keep up with change, and M.I.T. seeks funds to underwrite the creation of programs to serve the professional development needs of alumni and others. These new programs will offer general professional education and information about recent developments in a wide variety of professional fields; the stress will be on education in new fields that will assist practicing professionals in changing careers. Seed funds for pilot programs, faculty support grants, and public policy program funds are sought.

Support for Special School and Departmental Needs

\$20.0 million

The twenty-four individual academic departments at M.I.T. have a wide range of needs: appointments of visiting faculty who will enrich offerings in many departments, new laboratory equipment, curriculum development support, and improved programs for undergraduate research will at once improve educational opportunities throughout M.I.T.

New Facilities

A total of \$61.8 million for housing, athletic, and academic programs:

Undergraduate Houses

\$10.0 million

Additional housing is essential to accommodate students who seek to live on the campus — which M.I.T. regards as a vital part of an undergraduate experience — and to permit a carefully controlled growth in the undergraduate student body. New housing is also essential to a long-range housing improvement program as older residences must be temporarily vacated for renovation. One new undergraduate residence to provide for currently unmet housing needs is under construction and will shortly be in use; the project cost for this House, which can be named for a donor, is \$6.2 million; student rents will support at least \$1.2 million of this cost, and the remaining \$5.0 million is sought from private funding sources. A similar sum is also needed for a second new undergraduate house, planned for an additional 300 students.

Athletics and Special Events Center \$6.1 million

A new building is planned to house an indoor covered skating rink (replacing the existing outdoor uncovered rink where use is severely curtailed by inclement weather), a field house (which would provide a modern eight-lap, one-mile indoor track which would be readily convertible to indoor practice in baseball, lacrosse, and rugby during the frequent inclement New England weather), and a special events center for Commencement, for convocations of alumni and Institute-related groups, for campus-wide student and community social events, and for Boston-area activities. The new center will replace Rockwell Cage, now nearing obsolescence. The cost of this program is \$6.1 million, including \$3.0 million for general construction and the balance for a 10-year maintenance fund, other costs, fees, and utilities.

Other Academic, Activity, and Residential Facilities

\$45.7 million

This item contemplates new and remodelled classrooms and lecture halls and support space for the Sloan School of Management and closely related support space for the departments of Economics and Political Science; significant improvement and expansion of facilities for the School of Architecture and Planning; rehabilitation of classrooms, laboratories, and offices in Building 2 for the Department of Mathematics and of Room 10-250 as the Institute's principal lecture hall; substantial alterations to improve the efficiency of many libraries; new facilities — notably teaching and research laboratories and clinical space — in psychology; new quarters for the creative arts and for public events; and major new funds for fraternities through the Independent Residence Development Fund.

Unrestricted Funds

A total of \$20.0 million

Unrestricted gifts, grants, and bequests whose use is left to the discretion of the Institute play a crucial role because they allow critical flexibility in budgetary allocations, they permit M.I.T. to respond without delay to immediate or short-term capital needs, and they permit the application of resources to purposes of maximum future benefit. Such funds have in the past been decisive in the initiative with which the Institute has been able to enter new areas of concern to the nation and industry, and additional funding is needed for the future.

came the Second Century Fund, a \$60 million campaign devoted chiefly to extensions to the Institute's physical plant.

Recalling these efforts in which he had a major role, Dr. Killian told the Alumni Advisory Council that he has "great confidence" that the Leadership Campaign goal will be met, that "this towering peak among educational institutions will remain one."

He bases this judgment primarily on his "deep feeling of confidence" in the Institute's alumni — "an aristocracy of those who care about this institution," he said. "We will desperately need the help of all alumni — and we will have it."

Mr. Hellmuth, who is Co-Chairman with Mr. Johnson of the Leadership Campaign, is a relative newcomer to M.I.T. alumni affairs; he was elected to the M.I.T. Corporation in December, 1974. But he is widely known for generous service to many community enterprises in the Greater Boston area: Chairman of the Board of Directors of University Hospital, First Vice President of the Board of Trustees of Children's Hospital Medical Center, Director and former President of the Boys' Clubs of Boston, Inc., President of the New England Aquarium, and a trustee of the Museum of Science and the Museum of Fine Arts.

Mr. Hellmuth studied in the Sloan School of Management in the same year (1947) he received his LL.B. degree from Harvard; he was graduated from the University of Notre Dame in 1940. He joined the Boston law firm of Hale and Dorr upon completing his law degree at Harvard, became a Partner in 1952, and was made Senior Managing Partner in 1956.

Understanding "the True Nature of Progress"

Why, in the final analysis, a Leadership Campaign for M.I.T.? The question was answered for members of the Alumni Advisory Council on April 22 by Julius A. Stratton, '23, President Emeritus: Out of all recent argument about the role and value of technology, said Dr. Stratton, "there is emerging a more profound and rational understanding of the true nature of progress and of the extent to which the future of our society depends upon the resources of science and technology."

"This is not a perfect world; it never has been; it never will be. But never before has such a store of knowledge and power been entrusted to man," said Dr. Stratton.

"As an institute of technology, we are by our very nature constantly enmeshed in some of the most perplexing problems of our time, and the society to which we look for support has every right to look to us for enlightened, humanistic leadership in science and engineering. . . . Never before, in my judgment, has that need been greater than it is today." □

Nuclear Engineers for Iran To Be Trained at M.I.T.

A special program to train up to 54 Iranian graduate students over the next three years in nuclear power engineering will begin at M.I.T. on June 1. The program will be financed up to \$1.3 million from the Atomic Energy Organization of Iran (A.E.O.I.), and its students will eventually help Iran establish nuclear power plants in that nation's electric power industry.

Of the 27 positions made available by M.I.T. for the first year of the program, 23 students were accepted out of 50 interviewed by Professor Kent Hansen, Acting Head of the Department of Nuclear Engineering, during a trip to Iran early in the spring. The second program, also with an upper limit of 27, will begin in June, 1976.

Announcement of the program triggered a considerable campus debate (see below), the questions having to do with the program's effect on Iran as a world power and on M.I.T. and its regular students; the Department's normal enrollment is between 110 and 150 graduate students.

Professor Hansen explained that the normal admissions process for graduate students was completed by the Department before the selection was made for the special Iranian program. Thus, he emphasized, the admissions process was in no way affected by the new program — each Iranian application was expected to meet the same high standards required under normal circumstances.

The program "is in line with what we've been doing for many years now," explained President Wiesner at a seminar sponsored by Chi Epsilon, an engineering honorary society. "We've long been educating students from underdeveloped countries. Iran can expand on a more rapid basis now, and so we are expanding their programs accordingly," said President Wiesner.

The A.E.O.I. will pay the full costs of the program, estimated at \$10,000 per student per year, plus the cost of computer use, space modification, and administrative overhead. "The only possible way M.I.T. could assist Iran in fulfilling its goals was to develop a special program under which A.E.O.I. would pay for all actual costs and not expect M.I.T. to incur any financial loss," Dr. Alfred Keil, dean of M.I.T.'s School of Engineering, said.

Though M.I.T. does not expect to profit financially from this program, there are definite advantages to be gained. It will enable the Department of Nuclear Engineering to increase the size of its faculty; more effective use will be made of the Department's facilities, such as the nuclear reactor used in teaching; more student aid will be available in the form of teaching assistantships, so more junior staff people will be able to test their interest in teaching

careers.

Discussion for this program began last summer when a representative of the Iranian Embassy approached M.I.T. officials on the subject of training a substantial number of nuclear engineers. M.I.T. responded with a proposal to the Atomic Energy Organization of Iran, which was accepted by Iran in mid-March. The Iranian students trained at M.I.T. will only represent a fraction of the several hundred nuclear engineers needed to implement Iranian plans; others will be trained in Iran and elsewhere.

"Iran has earned a worldwide reputation for farsighted planning," says Dean Keil. "Iran's stated national plan is to use the considerable revenues being generated by the current Middle East oil boom to build an industrial base for the future." A nuclear power source, to be developed over the next two to three decades, will sustain industrial development when Iran's oil energy source is depleted in 30 years. Iran has already purchased nuclear reactors from France and West Germany, and is presently negotiating with the United States.

In considering the Iranian request, the Department of Nuclear Engineering "satisfied themselves that M.I.T. would not be contributing to some unannounced and covert plan to use the nuclear power indus-

try as the basis for developing nuclear weapons." Iran has signed the 1970 Nuclear Non-Proliferation Treaty which specifies that spent fuel from reactors will be processed under international supervision to insure that the plutonium generated will not be used to make weapons.

Additionally, the curriculum for nuclear power engineers at M.I.T. would not include the training necessary for the design of nuclear weapons. That is a "non-nuclear" problem, said Professor Hansen, and would require a different set of engineering skills. "There is nothing in the training of a nuclear power engineer that gives that person a special or unique ability to use this information for weapons design and fabrication," Dean Keil said.

"If nations such as the United States and others are to tell underdeveloped countries that they cannot have the benefits of nuclear power, then there is no question that the Non-Proliferation Treaty itself will crumble," Professor Hansen said.

M.I.T.'s responsibility, said President Wiesner, is to do everything it can to persuade people — especially political leaders — of the problems and the necessity for international control. With the review of the Nuclear Non-Proliferation Treaty before governments now, that task is an important one.

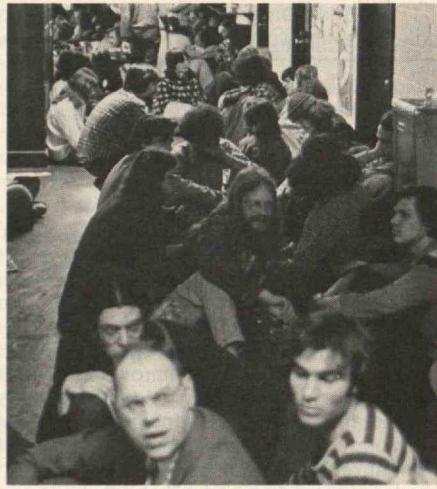
Considering the "Serious Implications" of a New International Commitment by M.I.T.

The most intense debate of recent years was generated in the M.I.T. community in response to the program to accept a large number of Iranian students for graduate training in the Department of Nuclear Engineering (see above). Special faculty meetings, seminars, and pages of newspaper print were devoted to a complex variety of issues and views.

Does the M.I.T. contract with the Atomic Energy Organization of Iran have implications for foreign policy? Iran was described by some as one of the most repressive governments in the world. Should we be "collaborators with totalitarians?" Is it the people of Iran that we are aiding?

Others questioned the impact of such a program on M.I.T. Will there be a proliferation of similar programs in the next few years that could change the character of the Institute? Does such a program establish a precedent whereby admission to M.I.T. becomes a "purchaseable commodity"? And what of the informal "quotas" which have traditionally limited the numbers of foreign students at M.I.T.?

Most felt uncomfortable making a judgment regarding the program's affect on nu-



The halls of the Department of Nuclear Engineering became a center for protest when students and faculty held a "sit-in" demonstrating opposition to the program to train nuclear engineers for Iran. Professor Kent Hansen, Acting Head of the Department of Nuclear Engineering (front center) discusses issues with students. (Photo: Peter N. Kaufman, '76)

clear proliferation without more information and discussion. But the question was clearly in many minds.

Philip Morrison, Institute Professor of Physics, saw the controversial program as a "symbolic issue of the nature of technology and society." It concerns "the legitimacy of a university's behavior," particularly instances which could be construed as affecting or even making foreign policy. M.I.T. works well, said Morrison, because it's autocratic. A democratic process would be more complicated but perhaps better in the long run.

There are two main issues, President Wiesner stated at a faculty meeting: "The education process and how it is carried out, and the moral implications and responsibilities of our research activities." On the latter, the President said, "I draw back from making judgment," but suggested a forum for discussion and debate.

But President Wiesner cautioned, "I don't want to change the governing structure of the Institute" in a way which would interfere with an expedient process for normal situations. Professor Emeritus Gordon S. Brown, '31 agreed: "The administration must run the Institute. The question is how does it seek to obtain the necessary advice and council of its constituents."

Because a contractual agreement had already been made — any changes now, Chancellor Paul E. Gray, '54 told the faculty, "would have serious and long-range consequences" on future negotiations — many felt it too late to change the course of this particular program. But they sought a mechanism to review the decision-making process for potentially controversial programs in the future. The faculty overwhelmingly approved the establishment of an ad hoc Advisory Committee to review "the procedures which have been followed in cases where international institutional commitments have been made, including the Nuclear Engineering Program."

Students Oppose Program

Students said they found all this debate "provincial." The instability in the Mideast, Iran's increasing political power, and the Iranian government's history of political torture and repression make any contractual agreement with Iran an expression of *de facto* support by M.I.T. for a reactionary Middle Eastern regime. Any contract providing technology to the Shah of Iran "will have the effect of bolstering up and militarily strengthening the incredibly repressive government," it was stated in the M.I.T. newspaper, *Monday*.

Students voted 1001 to 214 for non-implementation of the Nuclear Engineering program on a referendum question at an Undergraduate Association election. Later, at a meeting to discuss the administration's response to the referendum, Sloan School Dean William F. Pounds told over 300 students that the administration "would take the vote into consideration in future programs."

Over 150 students and faculty staged a sit-in at the Department of Nuclear Engineering, the first action of what was promised as a continuing effort to block the program, to challenge the administration's "in-

sensitivity" to student opinion and to expose the larger issue of "the American government's continuing policy of propping up autocratic and repressive governments."

— Susanne Fairclough

"Liaisons" . . . "Councillors" . . . "Catalysts" Graduate Residents Are "Someone to Talk to . . ."

"We happen to be two people who simply enjoy community living. We leave our door open as much as we can, and we feel good when people knock when it's closed."

Not everyone's cup of tea, but that kind of spirit assures the successful tenure of Graduate Residents in M.I.T. houses and many fraternities.

The quotation is from Patricia Callahan, '74, who married graduate student John Wall last June and joined him in Burton House last September. They like the job because they "enjoy interacting with different people."

Tech Talk surveyed this year's Graduate Residents when the deadline for next year's applications approached, late in the winter. "Liking people," "living informally among many different social backgrounds," and "getting to know M.I.T." were recurrent phrases in conversations about why Graduate Residents chose dormitory in-

stead of apartment living. Here are some other anonymous comments:

"Graduate Residents at M.I.T. are many things: They are students like others on the floor and yet they are a little older. They are liaisons between students and the faculty and administration as well as other students. They are providers of food, concern, and academic counselling. They are catalysts of activity. But most of all, they are there when you need them. . . ."

"It's funny — in the eyes of the unmarried, being married and a Graduate Resident makes you someone to talk to."

"If the initial desire to help isn't there, or a commitment to students, then the day-to-day frustrations of the job will drive you right out of the realm of effectiveness. Call it motivation — or faith, almost — but it ends in channelling energy otherwise reserved for one's own life to helping others. . . ."



Gary and Becky Siebert — he is a graduate student in biology — like being Graduate Residents in MacGregor House: "It's good, living the way we do." Reeta Karmarker, whose husband is studying in the Sloan

School of Management, agrees: She finds "the fabulous courtyard, spontaneous study-break revelries, and warm people" of Senior House have changed her view of life.

Inflation Pushes the Budget off Balance; I.B.M. Cards Up 270%

Pushed primarily by the thrust of inflation, the excess of M.I.T.'s expenditures over available unrestricted funds in 1974-75 will be at least \$1.1 million higher than was expected last fall. But Paul E. Gray, '54, Chancellor, continues to pledge that expenditures and current funds will be brought into balance by July, 1977, and that unrestricted funds will once more be available for special purposes, instead of exclusively for current expenses, after July, 1978.

Reporting to the faculty last fall, Dr. Gray forecast a total need for \$6.6 million in unrestricted funds for current operations in 1974-75; of that total, \$3.2 million would have to come from prior years' funds or from reserves. By April that estimate of need from prior years' funds or reserves had grown to \$4.3 million. Three principal factors:

— The prices of most goods and services the Institute buys continue to increase.

Take paper, for example: the Institute's Information Processing Center (I.P.C.) budgets \$300,000 a year for computer paper and punched cards. There have been seven price increases in punched cards since July, 1974, and the price is up an aggregate of 270 per cent. Paper for the first three issues of *Technology Review* cost \$6,000 more in 1974-75 than in the previous year.

— Some forms of income have declined; for example, faculty members — conscious of the pressure of inflation on research budgets — have sharply reduced their use of computer services, exacerbating the imbalance between I.P.C.'s income and outgo which increases the need for general funds in support of I.P.C. operations.

— Though the total of gifts and grants to the Institute has been maintained and even increased over 1973-74, more of this year's funds are coming for special projects and less as unrestricted gifts.

Dr. Gray's expectations for 1977-78 and 1978-79 are based on four conditions, and achieving some of them will be a tough order for M.I.T.:

— There will be a "continued modest growth" in the number of students at M.I.T.

— an average increase of perhaps 200 a year for the next three years.

— Salary increases which will average about 8 per cent for 1975-76, will be in the range of 5 to 6 per cent thereafter; these will in all probability be less than the rate of inflation.

— The Institute's increased efforts in fundraising will yield new resources applicable to current programs in time to have a significant effect on the budget for 1976-77.

— "A hefty budget reduction" will be necessary in 1975-76. By that, Dr. Gray explained to the Administrative Council, he means a drop of \$500,000 in academic budgets and of perhaps \$3.0 million in general and administrative (support) budgets. If achieved, this would represent a cut of about 7 per cent from the "G and A" 1974-75 budget, a significant reduction in a series of activities which have already been pared by budget cuts made in three previous years. Some 70 per cent of the "G and A" budgets now represents salaries and wages. Queried by Deborah Shapley of Science, Dr. Gray this spring admitted that "we'll certainly end up with some staff reductions. . . . But whether they will be achieved through attrition or layoff we don't know yet." □



You remember your college interview as an ordeal striking terror in your heart and intimidating your mind and tongue? Perhaps it would have been different if your visit had been with a person such as one of these — Barbara L. Moore, '75, and W. Thad Byrd, '74. Both have been serving this year as part-time interns in the M.I.T. Admissions Office, and interviews with prospective students have been among their tasks. Peter H. Richardson, '48, Director of Admissions, thought it a good idea: "High school seniors want to hear it like it is from someone whom they consider a contemporary," he says, "and I don't qualify."

Planning for the Largest Freshman Class in History; but No Precedent Can Be Assumed

Between 1,130 and 1,150 freshmen will come to M.I.T. in September as the Class of 1979; it will be the largest class ever to enter the Institute.

Five factors moved the Academic Council to instruct Peter H. Richardson, '48, to bring to M.I.T. a class of that size, according to Hartley Rogers, Jr., Associate Provost:

— A "sense of M.I.T.'s obligation" to provide more of "our kind of training" to a society frustrated by increasingly complex and interrelated technological and social problems.

— The availability of new housing: The first half (150 beds) of a new undergraduate dormitory west of MacGregor House will be ready by September 1 and the second half (another 150 beds) just a month later.

— The pressure on financial resources (see above), which drives the Institute to "use our facilities as efficiently and effectively as we can." The Academic Council concluded that M.I.T. could accept a "somewhat larger" number of undergraduate students without any compromise in educational quality, said Professor Rogers.

— An expressed desire on the part of administration and faculty alike to increase enrollments in departments whose graduating classes have traditionally been very small.

— The growing number of M.I.T. undergraduates who complete their degrees in less than the nominal four years. The result, of course, is that increasing numbers of

entering students do not necessarily imply equivalent increases in total undergraduate enrollment.

On the other hand, the decision to admit as many as 1,150 freshmen next fall may mark the beginning of a modest increase in M.I.T.'s undergraduate programs. But there is no prospect, thinks Professor Rogers, of a change in M.I.T.'s policy that requires first-year students to live on the campus or in fraternities and encourages other undergraduates to do so, too. The faculty considers that "the housing system is an important part of the high quality of an M.I.T. education," he says.

As of 1974, 8 per cent of M.I.T.'s undergraduates finish bachelor's degrees in three years, and many of those who go on to graduate work take with them graduate-level credits from their undergraduate years.

"The Difference Is Hardly Measurable"

Mr. Richardson and his admissions staff could choose the Class of 1979 from about 100 more applicants than a year earlier, when the target was an entering class of only 1,000. This year there were final applications from 4,546 high school seniors — 3,893 men and 653 women. Last year the comparable numbers were 4,444 — 3,543 men and 901 women.

• Minority applications were down 59 from 330 a year before to 271 this year.



As winter ended, construction was proceeding apace on a new dormitory scheduled for occupancy next fall. Its beds, in fact, give M.I.T. an opportunity to

admit the largest class in Institute history in September, 1975. (Photo: Mark James from *The Tech*)

Mr. Richardson is unconcerned about the slightly greater numbers. "We feel that the difference between enrolling 1,000 and 1,130 is hardly measurable as far as quality is concerned," he said when the new goal was announced. "The significant characteristic of M.I.T. applicants over the years has been their quality — and it will be a pleasure to welcome the additional members to the class."

The decline in applications from women and minorities was a matter of more concern. Competition was not, thought Mr. Richardson, the major factor.

"The decline in women's applications shows that not all women are liberated in their thinking about personal professional development," he said; "we're just going to have to keep sending our message out and hope that it's heard." One M.I.T. coed had a fairly simple explanation. Speaking at the mid-winter meeting of the American Physical Society and the American Association of Physics Teachers in Anaheim, Calif., Sandra G. Yulke, '74, recalled that M.I.T. organized an intensive mail and even telephone campaign to suggest that women apply for the Class of 1974; 10,500 admissions booklets were mailed to women on the basis of their College Entrance Board scores, and there was national publicity in such magazines as *Ms.* and *Parade*. This year the booklets went to only 4,000 women, and the result — some 250 fewer women applicants — is "not surprising," said Ms. Yulke; she is now a graduate student in the Department of Earth and Planetary Sciences.

Minorities present a different — and more frustrating — problem. "The country faces

major difficulties in the delivery of education to minority groups at the elementary and secondary levels," he said. "There are simply more opportunities for minority students in college than there are students whose educational backgrounds prepare them for demanding math-science based curricula." □

Applications: the Trend Is (Slightly) Up

M.I.T. is not alone in having more applicants for the Class of 1979 than in recent years. As of January 1, 43 per cent of more than 500 private colleges and universities surveyed by the Association of American Colleges were having a similar experience; applications were holding steady at 25 per cent of the institutions and were down at 32 per cent, according to *Chronicle of Higher Education*.

There have been some spectacular longer-term increases; according to a Georgetown University survey of three-year admissions trends, applications have increased by 75 per cent at Dartmouth since 1972, at Holy Cross and Williams by 35 per cent, at Georgetown by 34 per cent, at Bryn Mawr by 32 per cent.

Fraternities: Finding a New Identity

Fraternities still "alive and kicking" at M.I.T.?

More than that, says Peter J. Mancuso, '75, Chairman of the Interfraternity Conference. "The system is getting better and better," he told John M. Sallay, '78, of *The Tech* last fall. That's in terms of "their internal organization, the spirit and pride of living groups, the contact and communication with other members of the system. . . ."

Changes in the role of fraternities at M.I.T.?

After what might almost be considered a revolution five and six years ago, said Mr. Mancuso, the fraternity system has now found "a kind of new stability. . . . It's becoming more involved in the affairs of the Institute . . . and it's just a matter of time now before they are reintegrated fully into a system we pulled out of a long time ago."

What about fraternities going coed? (Two have done so, and a third will accept women residents next fall.)

"M.I.T. requires that any living group which goes coed must first have a large enough number of upperclass coeds to help newcomers during a transitional period. Last year Pi Kappa Alpha [met that condition], but other fraternities have had trouble getting enough coeds. I suspect that the problem is more often than not because people just don't want to move. . . ."

A sorority at M.I.T.?

Not very possible, thinks Mr. Mancuso, whose predecessor as I.F.C. President worked hard to interest a sorority in M.I.T. But "I dropped that project because I didn't see a good potential for it actually coming off. This year L. Zaurie Zimmerman, '78, tried to get a sorority started but the interest turned out to be very weak. . . . I don't see it as a likely possibility."

In view of problems in the Back Bay, what about fraternities moving from Boston to Cambridge?

The problems are very real. Back Bay houses are old and many need renovation. Building codes leave many of them outdated, zoning restrictions prohibit acquiring new properties, and the local historical association requires strict maintenance of original exteriors. If repairs reach 20 per cent of the house's value the protection afforded by grandfather clauses is lost, and then the job has to be expanded to include everything that will bring the house into full compliance with all codes. The question of what to do is plaguing many houses, and Phi Kappa Sigma and Sigma Chi seem to Mr. Mancuso most likely to try to make changes soon.

How can they make such a move?

Consider the Independent Residence Development Fund, established to provide loan funds for fraternity housing. Interest can be as low as 3 per cent for up to 40

years. Reporting to alumni this winter, Glenn P. Strehle, '58, Chairman of the Alumni Interfraternity Conference, said I.R.D.F. in ten years had received a total of \$1.3 million. That's been used to benefit 12 fraternities; now none is left, and at least two houses are waiting in line.

Mr. Strehle estimates needs for I.R.D.F. funds at \$12 million in the next decade. A big job, he admits.

New fraternities at M.I.T.?

"No efforts currently in progress," said Mr. Mancuso. But "it could very possibly happen (in the next couple of years), because M.I.T. has an excellent name as far as fraternities go." □

"A Fraternity Is Not A Place To Live; It's People To Live With"



James B. Gust, '75

Technology Review asked James B. Gust, '75, of Minneapolis, Minn., to write about his affiliation with Sigma Nu, an M.I.T. fraternity. A fifth-year student in chemistry and urban studies and planning, Jim was Commander of Sigma Nu during 1973-74.

During my four years as an M.I.T. undergraduate, I have lived in a fraternity, Sigma Nu — an experience which no doubt shaped my education in a fundamental and qualitative way.

Sigma Nu was smaller than most M.I.T. fraternities (the average membership has been 31), so we are a closely-knit group.

I joined Sigma Nu in 1970 during its first year of "coedity." That spring, the M.I.T. chapter of Sigma Nu had decided to establish a program which would eventually allow women membership in the national fraternity. In a technical sense, a new group was formed that fall, called "the House," with both men and women members.

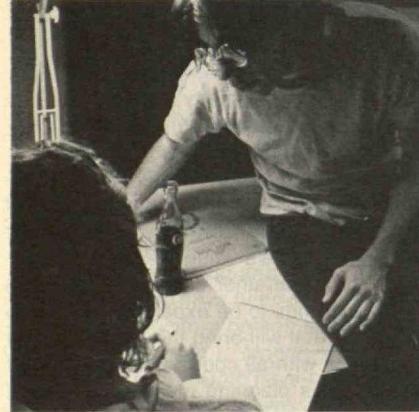
Although women were not initiated into Sigma Nu, they were full and equal members of a living group where all could live, work, and interact on a nonromantic, nonsexual level — a valuable relationship between the sexes. Most people considered

this kind of relationship unusual; we expected it to become the norm in a coed fraternity.

I did not choose Sigma Nu for the prospect of coedity. What I liked were its location in Brookline, a quiet, residential neighborhood about two miles from M.I.T., and its friendly, independent-living atmosphere. I needed Brookline's suburban environment to balance M.I.T.'s highly urbanized surroundings, and I liked the Sigma Nu house, a converted three-story Victorian dwelling.

Since I had never been part of the "in" crowd in high school, I welcomed the opportunity to learn from and about a social group, and I quickly formed an identity with them. And while I was not involved in setting the goal of admitting women to Sigma Nu, I did participate in subsequent lobbying efforts, and this drew me even closer to those living at Sigma Nu. As a freshman, I found my friends at Sigma Nu greatly supportive while I underwent the psychological adjustments of coming to college.

Sigma Nu was an odd combination of conservatism and progressivism: some traditions were closely adhered to while others were changed or eliminated. The fraternity was founded on the tenets of love,



Sigma Nu — where both men and women "could live, work, and interact on a nonromantic, nonsexual level" says James B. Gust, '75. Glimpses of life in a coeducational environment. (Photos: James B. Gust, '75, Valva R. Vebra, '75)



truth, and honor — tenets which the M.I.T. chapter strongly emphasized as being the basic guidelines for both daily interactions and broader goals and directions for the group. Whenever there was a major undertaking, such as the transition to "coedity," it was done the "right" way, never in a sloppy, half-hearted, incomplete manner. Record-keeping and finances were highly conservative, and the authoritative hierarchy within the group was well-defined and clearly understood. But Sigma Nu was highly responsive to changes in its social environment, as demonstrated by the admission of women in 1970.

The group meant something slightly different to me each year, and each year I learned more about the explicit and implicit meanings of "fraternity." Sigma Nu reinforced learning in an academic sense. By having study hours and studious upper-classmen who very visibly set an example, academic achievement became easier. This might be the most direct link between formal education and fraternity life; however, the less tangible education was even more important.

I learned how a living group works and how to live and work within a group. By observation and later by practice, I learned the characteristics and importance of sound leadership — and how to develop it. After the successful achievement of the change to "coedity," I formed close friendships with members of both sexes, and I learned much about men, women, and their interrelationships.

Most importantly, I learned about myself. A fraternity does not provide a unique opportunity for this kind of learning, but the best way to learn about oneself is to interact extensively with other people; this I did.

Sigma Nu by that name came to an end in 1974 when the election of a woman as leader of the M.I.T. chapter resulted in the chapter's suspension. The group, now known as Epsilon Theta, is a local fraternity and is doing well. I found, as I was told before I joined, that a fraternity is not a place to live; it's people to live with. □

Engineers, and other scientists and health professionals. In addition to diagnostic and therapeutic work, the program will concentrate on the design, fabrication, and evaluation of bioengineering equipment for children whose disabilities foreclose the use of existing therapy or apparatus.

Dr. William Berenberg, Senior Associate in Medicine at Children's Hospital Medical Center who is President of the Center's medical staff, is R.E.C.'s Director; M.I.T. participation is under the auspices of the Harvard-M.I.T. Program in Health Sciences and Technology, and a number of members of the faculty are taking part. □

M.I.T. Aids Spanish Research Center

A new form of higher education in technology for Spain, to be achieved with financial support from Spanish industry and advice and consultation with M.I.T., is now being implemented. Privately financed, privately administered and totally autonomous, the Spanish Graduate Research Center will provide an opportunity in Spain for students who have their first professional degree to spend a period of internship working as partners of practicing professionals (the faculty). Selected features of the graduate facilities and teaching methods at M.I.T. will be adopted, as will a pragmatic approach: learning by doing, seeking solutions to scientific and technological problems of vital concern to the future of Spain. It will be the first example, according to Dean William F. Pounds of the Sloan School, of high-level graduate instruction and research in science and technology in Spain.

An agreement for collaboration reached during a week-long trip to Madrid late last year by Dean Pounds, Gordon S. Brown, '31, Institute Professor Emeritus, and Paul E. Gray, '54, Chancellor, was the culmination of several years of correspondence between Professor Brown, Luis de Guzman, '60, President of Iber Electronics, and Manuel Cabrera Kabana, '60, who is associated in business with Mr. de Guzman.

Spanish applicants for admission to M.I.T. graduate programs, and those Spanish professionals who seek temporary exposure to M.I.T., will participate in the special programs.

Professor Frederick J. McGarry, '50, of the Department of Materials Science and Engineering will be the link between M.I.T. and the Spanish Graduate Center.

The cost of the Research Center's first phase of development (buildings, plant, and curriculum development) is estimated at approximately \$20 million. Funds have already been committed by the Foundation of the Instituto Nacional de Industria (I.N.I.) and the Foundation of the Compania Telefonica Nacional de Espana (C.T.N.E.), the

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A Rehabilitation Center for Children's Problems

A new Rehabilitation Engineering Center, a joint project of Harvard Medical School, M.I.T., and the Children's Hospital Medical Center which is designed to find new ways of helping children with special disabilities, is now in place at Children's Hospital, Boston. It is made possible by a \$335,000 grant, which continues an earlier grant to M.I.T. from the Department of Health, Education and Welfare.

The special force of R.E.C. will be the close collaboration of physicians, en-

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nation's telephone company and largest employer. The I.N.I., which manages the Spanish government's participation in industry, includes among its list of holdings Iberia Airlines, S.E.A.T., Spain's chief auto manufacturer, and numerous companies. □

bring the case. It's not fair play — but lawyers consider it part of the game.

The blocking of patents has serious consequences, Mr. Rines told the students. Other countries have taken the technology we developed here and are beating us to the punch in our own marketplace. "Can you think of a brand of TV tubes or stereo equipment sold by an American company?" he said. "And our great leaders look up and cry 'My God! We have no jobs for our people!'" Economists fail to see what invention and innovation mean to the starting of new enterprise — that they are essential to sustain technological leadership.

The Supreme Court has proposed that there is no need of patents; that they cause monopolies. And the Supreme Court has the power to force those beliefs on society, said Mr. Rines. He disagrees strongly; but Mr. Rines admits that the patent system must be changed, and he has taken steps toward that end. As Dean and founder of the Franklin Pierce Law School in Concord, N. H., his hope is to build a generation of intellectually honest lawyers who have the integrity to refuse a client's request if it is wrong; to play the game with new rules. □

Games Lawyers Play

The qualified answers of a scientist are out of place in the quasi-political arena of the adversary legal system. A lawyer has to present a black-and-white case — even though the truth may be best represented by gray, Robert H. Rines, '42, told M.I.T. undergraduates considering careers in law. From his experience as a patent attorney:

As a lawyer, you will use an approach different from that of a scientist — you must learn what has been decided in the past and then use your ingenuity to structure your case within those guidelines. A lawyer is not to change things, not to establish new law. He must learn to present a strong case, emphasizing only one aspect of his knowledge. He must define for himself what "honest" means.

You will be faced with frustrations, Mr. Rines said. The judge is not technically oriented. You must baby-talk him until he can understand; then show him the issues. The judge then decides, with little depth of understanding, who is telling the truth. And when you seek a patent, it is not enough to have invented something new; your invention must have been "something that wouldn't have been obvious to someone with ordinary skill in the art." But who is someone "with ordinary skill in the art"? Hindsight is a great thing — how relatively simple it is to see a new idea when given the parts and shown how they fit together. Try to go back before that discovery . . .

There are times when the system seems to be a mockery. In one case two professors presented opposing views: the younger said it was a breakthrough invention; the older, that it had been around in 1897. The judge confessed that he didn't understand the issue at all — so he would take the word of the older professor because of his greater experience. And on two occasions, a judge told Mr. Rines he would never approve a patent, whatever the evidence.

When you take your case before a jury, it's a whole different ball game — all fakery. If you start dramatizing in front of a judge, he'll tell you to cut it out. But for a jury, you have to be Perry Mason. You must call witnesses and start from scratch: their identity, their credentials, all according to archaic laws. The usual decision is the easiest one: the invention in question "would have been obvious."

There has been no clear definition of an invention under new patent law. Varying opinions in different parts of the country result in "forum shopping": searching for a sympathetic part of the country in which to

Bringing Law to Life

Three ways the Massachusetts Port Authority, operators of Logan International Airport in Boston, might respond to complaints from East Boston residents of noise from low-flying aircraft:

- Finance soundproofing in affected homes.
- Make "annoyance payments" to residents afflicted.
- Buy residential property and change it to other uses less affected by noise.

What would each cost? And how cost-effective would it be?

This field project, tackled by a team of M.I.T. and Wellesley students last summer, is typical of those on which more students will work in 1975. It all happens under the aegis of an Urban Legal Studies Program, the idea of which is to give students interested in law and public policy an opportunity for summer field work.

In addition to the noise abatement study, which will continue, the U.L.S.P. hopes to mount summer studies of environmental protection in Boston Harbor, the impact on New England of the 1973 Regional Rail Reorganization Act, and other subjects in which technological background can help enlighten legal and policy issues.

Thomas F. McKim, '75, who will graduate from M.I.T. in civil engineering next month and plans to attend law school next year, coordinated the 1974 summer study, and for him it worked: "A student's education takes on additional meaning," he told *Tech Talk* this spring, "when he or she can see its potential application for the future through community projects." □

Tourists — Who They Are and Why They Come; But What Will They Do for the Bicentennial?

How many tourists will celebrate America's Bicentennial by traveling to New England this year and next? And how many of these will come to M.I.T.?

No one knows.

And no one at M.I.T. knows how to be ready for a stream of visitors of unknowable size. Can there be any clues in two recent studies of who comes to the Institute in an "ordinary" year, and why? Those findings, in a nutshell:

— Between July 2 and August 20, 1974, 717 visitors took the 90-min., student-guided tours of the Institute offered by the Information Center and the Admissions Office.

— As many as 30,000 alumni have visited the campus within the last five years, at least half of them on "casual" visits outside the networks of alumni and professional relations.

Mary L. Morrissey, Director of the Information Center, asked summer tourists in 1974 to answer a simple questionnaire. The answers showed that by far the majority (70 per cent) of all those on the tours were prospective students (33 per cent) or related in some way to them (parents, 28 per cent; brothers and sisters, 6 per cent).

"I'm looking around to find out if I like the campus and if I'm going to file an application" . . . "to get a taste of what the school is like" were typical responses to Miss Morrissey's survey.

Of the remaining 30 per cent of visitors, half were simply curious tourists and half were families of Special Summer Program registrants.

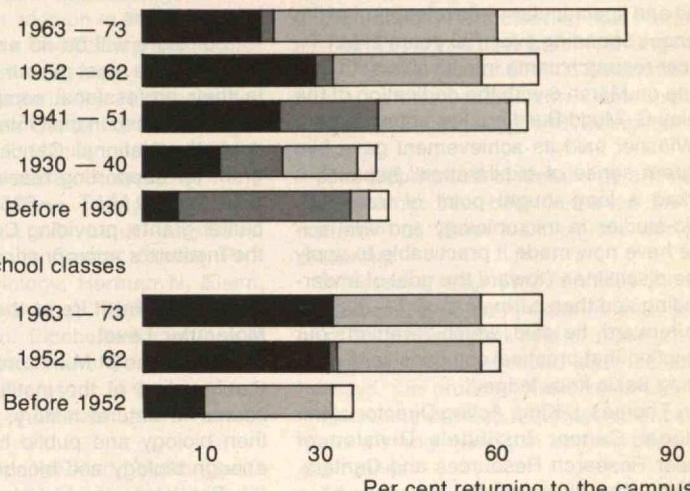
One-fifth of the visitors were from foreign countries; half were from the Northeast, just over 10 per cent each from the South and the Midwest.

"To See What's Been Going On"

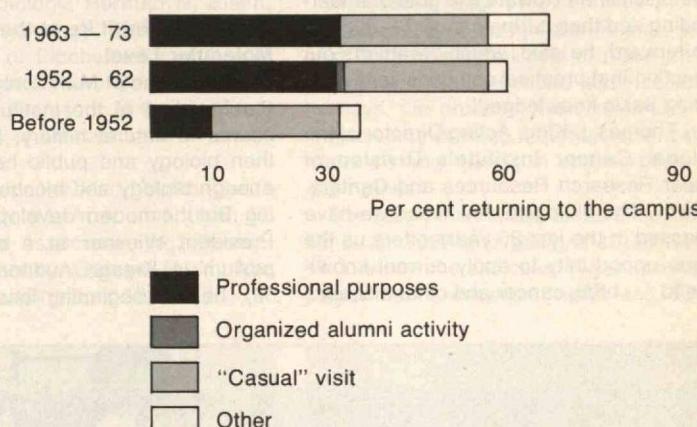
An intensive survey of alumni completed in 1974 (see *March/April*, pp. 74-79) suggested that as many as 60 per cent of all former students visit the campus in any five-year period. They come for many reasons — alumni activities, professional concerns, and (a surprisingly large number) casual curiosity — "to see what's been going on" and to show their alma mater to family and friends.

Summarizing their results, Constantine B. Simonides, Vice President, and his associates who surveyed the alumni wrote, "The important point that seems to emerge is not only the diversity but the high frequency of informal contacts that alumni have with the Institute, apparently much higher in frequency than the more formally organized kinds of associations."

Undergraduate classes:



Graduate School classes



A survey conducted in 1974 revealed "a striking variety of informal communications and contacts between alumni and M.I.T.," writes Constantine B. Simonides, Vice President of M.I.T., and his associates in

the Analytical Studies and Planning Group. For example, 60 per cent of all M.I.T.'s graduates have been on the campus within the last five years, but only 7 per cent of them came for organized alumni activities.

Can a "Living Community" Live?

But how do you extrapolate from this data on the informal visits of alumni and the purposeful visits of most other Institute tourists to understand what the Bicentennial years of 1975 and 1976 will be — or should be — like in Cambridge?

Three *ad hoc* committees are confronting that question. One seeks to relate the resources of M.I.T. to the program of exhibitions which is planned by the Museum of Science; the idea, says Sanborn C. Brown, Ph.D. '44, Associate Dean of the Graduate School, is to offer lectures and other Institute activities correlated with Museum displays.

Another group will study how M.I.T. should participate in other Bicentennial events in Boston — special lectures, national meetings of professional societies, etc. There will also be a series of study

groups and conferences on major societal issues in which technology has a key role, organized and presented at the Institute during the Bicentennial period. Norman C. Dahl, Sc.D. '52, is now at work to define and develop this program.

And finally there will be mounted an effort to help Bicentennial-year visitors to the Institute see more than most casual tourists usually see — "to communicate what M.I.T. is like as a living community," says Barbara S. Nelson, Assistant to the President and Chancellor — "to show that this is a lively place, not a big machine."

But a question arises: If Bicentennial visitors arrive in the numbers some predict, can we host visitors in our "living community" without jeopardizing some characteristics of the community we want them to see? □

A Decisive Moment When Basic Knowledge Serves Practical Needs: One More Step Forward on Cancer

After a gradual — and then increasingly rapid and spectacular — development of life sciences spanning over 100 years at M.I.T., cancer research came into its own at the Institute on March 6 with the dedication of the Seeley G. Mudd Building. President Jerome B. Wiesner said its achievement gave him "a great sense of exhilaration" because it marked a long-sought point of transition: basic studies in microbiology and viral science have now made it practicable to apply these disciplines "toward the goal of understanding and then curing cancer" — a great step forward, he said, which "reaffirms our conviction that practical solutions lie in marshaling basic knowledge."

Dr. Thomas J. King, Acting Director of the National Cancer Institute's Division of Cancer Research Resources and Centers, agreed. "The biological revolution we have witnessed in the last 25 years offers us the unique opportunity to apply current knowledge to . . . bring cancer and other diseases

under better control," he said at a dedication luncheon.

"But there will be no easy answers," he warned. "We must put our trust in people — in their professional competence, in their dedication, and in their integrity." Hence, he said, the National Cancer Institute's program for supporting research such as will take place at M.I.T. — \$35 million in cancer center grants, providing Congress releases the Institute's appropriations.

Understanding Life at the Molecular Level

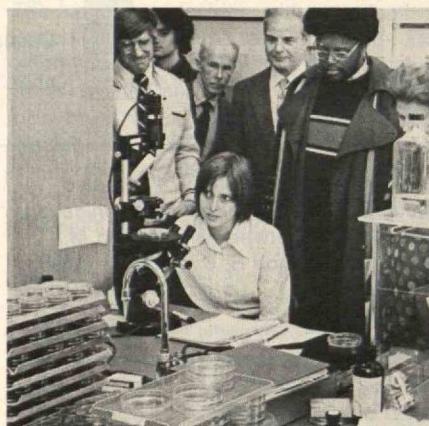
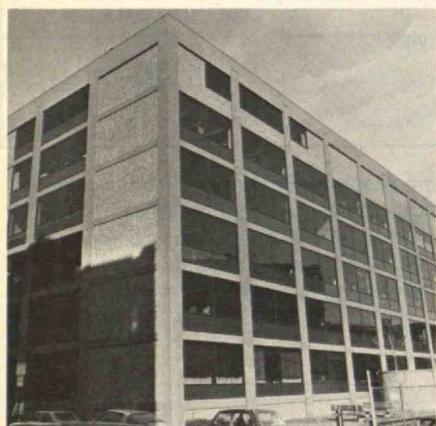
Biology began at M.I.T. only a decade after the founding of the Institute — first as a course in natural history, later in biology, then biology and public health, and soon enough biology and biochemical engineering. But the modern development, traced by President Wiesner at a dedication symposium in Kresge Auditorium (see page 58), had its beginning less than 40 years

ago, when the Department's teaching approach was "classical — meaning dull, at least in today's perspective," said Dr. Wiesner.

The quantitative fields of biology — biophysics, biochemistry, physiology, and microbiology — were brought to prominence at M.I.T. by Dr. Francis O. Schmitt, who is now Institute Professor Emeritus, and then they converged under the leadership of Irwin W. Sizer, now Dean of the Graduate School, into a new discipline known as molecular biology.

That was the decisive moment, said President Wiesner: "It soon became obvious that an understanding of life at the molecular level would provide a deep philosophical and intellectual insight into the nature of human beings, and that it would also have applications in the fields of agriculture, nutrition, and medicine."

By 1970 Dr. Salvador E. Luria, who first came to M.I.T. as Visiting Professor in 1958



From the outside, the Seeley G. Mudd Building conceals its industrial ancestry only frugally. But on the inside it is a gracious and efficient laboratory for the M.I.T. Center for Cancer Research, Cell Culture Center, and Arteriosclerosis Center. Shown (left, left to right) at dedication ceremonies in March are James R. Killian, Jr., '26, Honorary Chairman of the M.I.T. Corporation; Howard W. Johnson, Chairman of the Corporation; President Jerome B. Wiesner; Luther C. Anderson, Treasurer of the Seeley G. Mudd Fund; Dr. Robert D. Fisher, Chairman of the Fund; and Dr. Karl M. Franklin, Vice Chairman of the Fund. The portrait is of the late Dr. Mudd in whose honor the building was named. (Photos: Mark James, '78)

and now is Director of the Center for Cancer Research, was able to write President Wiesner that he was prepared "to attack directly the central problem: What properties of cancer cells are essential for malignancy? How do these properties originate? How can the formation and growth of malignant cells be inhibited and arrested?

"This direct approach," wrote Dr. Luria, "offers the hope of substantial advances within the not-too-distant future."

But he, like Dr. King, warned that "it will require many years and well trained scientists to bring about answers and solutions relevant to the multitude of different cancers. It would be naive to consider that the battle against cancer is a short-range project," said Dr. Luria.

A "Modern Miracle of Recycling"

The Seeley G. Mudd Building — an 80,000-ft.² former factory whose transformation into what Dr. Luria called "one of the most elegant and functional biological research buildings in the country" represents a "modern miracle of recycling" — bears the name of a pioneer in radiation therapy who was for many years a leader of the California Institute of Technology. Dr. Mudd studied chemistry at Harvard and in the last two years before retirement was Dean of the School of Medicine at the University of Southern California.

But most of his professional career was

devoted to cancer research and to medical education. During his lifetime he gave more than \$10 million to private colleges and universities, and the Seeley G. Mudd Fund established under his will has made 15 grants totaling \$22 million since Dr. Mudd's death in 1968.

Two federal agencies — the National Cancer Institute of the National Institutes of Health and the National Science Foundation — also contributed funds to make possible the Seeley G. Mudd Building. Accordingly, it houses in addition to the Center for Cancer Research a Cell Culture Center providing animal cell and virus cultures for laboratories throughout the Northeast and an Arteriosclerosis Center for interdisciplinary research (with Massachusetts General Hospital) on atherosclerotic diseases.

Among the building's distinguished residents — in addition to Dr. Luria — are David Baltimore, American Cancer Society Professor of Microbiology; Herman N. Eisen, Professor of Immunology; Phillips W. Robbins, Professor of Biochemistry who is in charge of the Cell Culture Center; and Dr. Robert S. Lees, Professor of Cardiovascular Disease who is Director of the Arteriosclerosis Center.

The architect for the Mudd Building was Marvin E. Goody (M. Arch. '51), John M. Clancy ('56) and Associates, Inc., Boston; construction was by George B. H. Macomber ('48) Co., Brighton, Mass. □

Four Thrusts in the Quest to Control Cancer

A four-pronged research effort in the Center for Cancer Research will seek to capitalize on what Robert A. Alberty, Dean of the School of Science, calls "man's growing power to understand and control biological processes." Here are descriptions of the four research thrusts as given by Dean Alberty at a luncheon for members of the M.I.T. Corporation on March 7:

Immunology deals with the immune system which recognizes and eliminates foreign proteins, as from an invading bacterium or virus, or — according to recent theories — from cancer cells. Understanding of this immune system is growing rapidly, and immunologists now think it may be possible to increase (as in the case of cancer) or decrease (as when an organ is transplanted) its efficiency when needed.

A virus is a molecule which has the ability to enter a cell and use its structures and compounds for the virus' own ends — namely, to produce more virus. Some viruses attach their genetic material to the genetic material of a cell without killing the cell, and when such an infected cell duplicates it reproduces the virus' genetic material as well as its own. If such a process can be controlled, the appli-

cation to cancer treatment is obvious. But control would also represent means to alter the hereditary material of cells and thus introduce new characteristics to their future generations. In this way it is already possible to give a bacterium the capacity to produce an enzyme or toxin that it did not have before. Such experiments open the possibility of distinguishing between normal and cancerous cells in a way that will help us understand the processes that lead to malignancy, and perhaps to control them.

Cell biology is important because cell cultures make possible studies — for example, of viral invasions — in the laboratory instead of in human subjects. At an earlier time it was possible to study viruses that attack human cells only in human beings — and in some cases in experimental animals.

Developmental biology deals with man's physiological interactions with his environment — including those factors which seem related to the incidence of disease and others which may be related to its remission. Such environmental conditions seem especially to affect some forms of cancer. □

Electrical Engineering and Metallurgy Change: Fitting Names to Work

Theorizing that the name of a department should describe the thrust and principal content of its teaching and research, the Executive Committee of the M.I.T. Corporation this spring gave two M.I.T. departments in the School of Engineering new names:

— The Department of Electrical Engineering — the largest academic department at M.I.T. — has become the Department of Electrical Engineering and Computer Science.

— The Department of Metallurgy and Materials Science has been renamed the Department of Materials Science and Engineering.

Professor Walter S. Owen likes the new name because it recognizes the emergence of a "truly integrated field of materials engineering." The new name was necessary, he says, "in order to make clear that our mission is to develop materials science and materials engineering in collaboration with each other."

The program in computer science, established in 1969 and designated as Course VI-3, is now the choice of 40 per cent of the Department's undergraduates and 30 per



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cent of its graduate students, according to Wilbur B. Davenport, Jr., Sc.D. '50. That fact, plus the Department's extensive advanced research in computers and information processing, justify the first change in the name of the Department of Electrical Engineering since its founding in 1902. □

University of Nebraska, Professor D. Quinn Mills of M.I.T., and Professor John T. Dunlap of Harvard — attracted special attention; Professor Mills was a member of the Construction Industry Stabilization Committee of Professor Dunlap's Cost of Living Council during President Nixon's first term. □

6,500 Bridges Between Research and Management

In a business where success is measured by numbers, this may look small: 6,500 circulation. Not so; for the *Sloan Management Review*, the product of three graduate student editors in the Sloan School of Management, is one of the largest management-school publications in the nation.

The point of the magazine, say the Editors, is "to bridge the gap between research and practice in management" — to "inform the practicing manager of ongoing research in management." An understatement, since the success of the journal is based not so much on "informing" as on "interpreting." The spring issue, published early in March, is an example: papers on advertising research, distribution systems planning, a case study of middle managers, and information for planning and control.

Three papers on inflation in the fall issue — by Professor Wallace C. Peterson of the



A Navy ensign (Michael B. Green, left) who wants to work in health care management, a biologist (Sandra L. Fiebelkorn, center) who wants to use managerial skills in a scientific setting, and an English major (Margery R. Weil, right) whose goal is to "improve the management practices of cultural institutions in general" will be the Editors of Volume 17 (1975-76) of the *Sloan Management Review*, three-times-a-year publication of the Sloan School of Management. All three are first-year graduate students in the Sloan School, chosen in a mid-year competition based on writing ability and a personal interview; only first-year students with averages of 4.0 or higher were eligible.

Draper's First Year: Stability and Optimism

Having completed its first year (1973-74) of independent operation, the Charles Stark Draper Laboratory, Inc., has reported total revenues of over \$87.3 million on direct contract costs of \$76.3 million. The latter figure compares with \$69.75 million of revenues and funds used by Draper Laboratory during 1972-73, the last year of the Laboratory's operation as a unit of M.I.T.

At the end of the first year, June 30, 1974, the Laboratory had completed arrangements for 43 new projects, 14 of them termed in the annual report as "new business with high potential in the field" and 15 of them "old business under sponsorship we have had before."

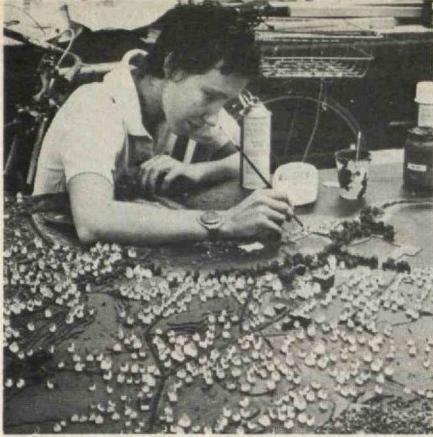
In addition, the Laboratory had begun a new program of independent research and development (\$1.55 million in 1973-74) in such fields as the atmospheric sciences, earth sciences, and oceanography; electronics; nonpropulsive energy conversion; materials; mathematical sciences; mechanical, industrial, civil, and marine engineering; missile technology; and navigation, communication, and space technology.

"At the end of the first year," wrote Robert A. Duffy, President, and Alfred G. Hill, Chairman of the Board, "our financial condition is stable and our business prospects for the next year appear reasonably bright." Employees numbered about 1,800, and "little change in total employment" was foreseen for 1974-75. □

The Case of Rockport, Mass.: Townspeople Turned Advocates

Lawrence Susskind is no ordinary teacher, and the report he (and his students) rendered to Citizens for Rockport, a community planning group in Rockport, Mass., was no ordinary town plan.

"He maneuvers kids to teach themselves," is how Ian Menzies, Associate Editor of the *Boston Globe*, describes Professor Susskind's teaching style (he is Associate Professor of Urban Studies and



A student team from M.I.T. helped a citizens' group collect data needed to plan the future of Rockport, Mass., last summer, and so many citizens became so successfully involved in the project that the recommendations of Citizens for Rockport were adopted without exception by the Rockport Town Meeting. The concept is that of Lawrence Susskind, Associate Professor of Urban Studies and Planning; the picture shows Jennifer Shakespeare, a graduate student in architecture, at work on the Rockport town model which was used to help the Town Meeting visualize Rockport's problems and opportunities.

Planning and Assistant Head of the Department). Given the assignment in August, 1974, to look at Rockport's future Professor Susskind assembled a group of his M.I.T. students to work with a group of Rockport citizens, and presently young people from Rockport High School also became involved. The result, as Ian Menzies describes it: " . . . they learned about the town by doing, by talking to people, taping interviews, examining records which in turn was teaching them about government, town finances, economics, state laws, and civil rights.

"The course was real, and obviously enjoyed," wrote Mr. Menzies.

Those who open the resulting report can hardly fail to find it comprehensive and detailed. They will also find its style unique and its approach direct: "I started downtown last weekend . . . and I just had to turn around before I got there. Too many people, too many cars — all for money. It doesn't seem worth it, somehow."

Or colorful descriptions of the shops which line the rocky harbor on the northeast shore of Cape Ann, 35 miles from Boston: "From Huckleberry Finn to the Cisco Kid, there's a hat to cap you, a wrist band to strap you in, and body jewelry for any piece of skin left over." And words of the shopkeepers: "Rockport? A great toy town. I came here because the harbor was just the right size for my lobster boats, and I figured our Red Baron biplanes could land and take

off on the sidewalks." . . . "It's close to the big stuff, the heavy commercial action, and yet it's far away, far out in its own special world. Having the sea all around, man, that's something special. A lot of nerves, a lot of petty hassles and tempers, just dissolve in the tides. The sea is serenity. I dig the smallness, the sense of community."

Even the conclusions have a flavor of their own: ". . . if the tourists were funneled into a municipal parking lot, Rockport might recover some of its ease and peace of mind, and residents might feel a lot less like Greenwich Villagers. Still and all, like a spring-time stream, the tourist trade discovers its own picturesque path and its own level. . . ."

Now a Rockport-like study is under way for Arlington, Mass., and the same survey-analysis sequence will be used. The clue, says Professor Susskind, is citizen participation. "Many people feel that they have no control over the decisions that affect their lives," and he wants citizens and his M.I.T. students to work together to deal with these frustrations. The result is "an educated core group of people who understand the issues and can argue for policy," reaching plans that are "supported by the people and not bestowed by consultants." □

M.I.T. Gospel Choir: We "Just Felt Like Singing Together"

Their repertoire ranges from the religious "Amazing Grace" to the 20th-century "Oh, Happy Day." Their monthly performances

occur in churches and on college campuses. Audiences not forewarned are often surprised by the name — the M.I.T. Gospel Choir — and almost always by the excitement and movement in their music.

Why would M.I.T. students form a gospel choir, and why would others join one? Lee Allen, '76, Musical Director, joined last year because "I like the music and I didn't know too much about gospel music; now I'm really learning." Ricardo Hall, '75, Choir President, founded the Choir three years ago because he and ten other M.I.T. undergraduates "just felt like singing together," says Mr. Allen. Now 33 members of the community have joined, and the Gospel Choir has been recognized this year as an extracurricular activity subsidized by both the Music Section of the Humanities Department and the Student Finance Board.

Mr. Hall likes gospel music's diversity as "a contemporary form with the potential of being interpreted with various arrangements." The Choir fulfills that potential with a varied repertoire in which rhythm and movement are constant qualities. Now Mr. Allen would like to add a rhythm section with drums and a bass guitar for a fuller sound.

Besides appearing at various M.I.T. functions — the M.I.T. Technology Conference, Christmas services, the Martin Luther King memorial service in January, and Building 7 lobby concerts — the Gospel Choir also sponsored a gospel music extravaganza last spring. Based on the warm response to that concert which highlighted eight other church choirs including entries from Wellesley College and Baltimore, Maryland, the Choir, as this article goes to press, is planning to hold another show on May 2 in Kresge Auditorium, the proceeds from which will benefit a local church or charity.

As Mr. Allen says, "We'll just keep on singing until there's nothing left to sing." □



The M.I.T. Gospel Choir, a newly recognized extracurricular activity, has grown in the three years since Ricardo Hall, '75, Choir President, and his fellow students decided they "just felt like singing

together." This photograph was made as the Choir sang at services in tribute to the late Dr. Martin Luther King. (Photo: Calvin Campbell)

The Writing Program: A New Thrust for Teaching a Skill and an Art



Writing plays an important role in every profession — writing technical reports, expressing personal opinions, even sharing emotions and experiences. Indeed, the ability to write well and clearly may mean the difference between success and failure.

Dismay over the inability of engineers and scientists to express themselves is a common sentiment; now the Humanities Department has created a new program designed to teach students, regardless of major, to write about their subjects and to help budding creative writers hone their skills. These two thrusts are embodied by the Writing Program, whose goal is to inject more vitality into the writing of students who

— without this kind of help — simply could not find words to coherently express their ideas.

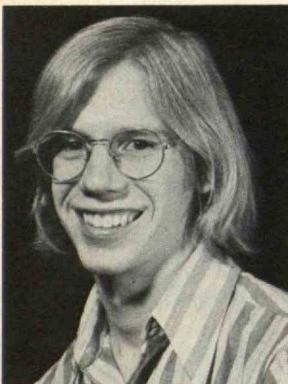
In one sense, Professor Robert R. Rathbone of the Literature Section, has been fighting a one-man battle for good writing for some 20 years; last year, his courses in technical and thesis writing and his lectures in M.I.T.'s professional schools reached 350 undergraduates. Creative writing has also been constantly growing over the past ten years under the watchful care of Professors Sanford Kaye, Patricia Cumming, Barry Spacks, and Elzbieta Chodakowska-Ettinger, assisted by Joseph Brown, Lecturer, and a group of part-time instruc-

tors, technical instructors, and undergraduate teaching assistants; there were 282 students enrolled in writing electives in 1973-74, and this year, although only nine students are designated majors — from all classes — there are 23 students concentrating on writing and literature.

Why a writing program at a predominantly scientific and technological school like M.I.T.? Three reasons are cited in the Writing Program's proposal:

— "To provide instruction in writing for every undergraduate so that students ... can communicate the results of their work to their professors ... and to a wider audience as well;

"Fundamental to the Way I Perceive Myself and My Life"



Christopher F. Dippel, '75

Technology Review asked Christopher F. Dippel, '75, of Glen Cove, New York, to write about the Writing Program at M.I.T. A life sciences major, Chris is a teaching assistant in the Program as well as a member of the varsity lightweight crew team.

Why do I take writing courses at M.I.T.?

I have often felt a conflict between the study of microbiological courses of my major and the attraction to a craft that has little to do with that prospective career. As I see it, a full-time scientist doesn't have the kind of time necessary to write, and my chances of being a professional writer are small. But I take writing courses because writing is fundamental to the way I perceive myself and my life. Writing allows me, through a small act of creation, to respond to the experiences of life and to express, refute, and shape the chaos around and within me. It is an act of the mind that joins me to the tradition of self-expression and I find that satisfying.

Writing also has the amazing quality of sharing with others the essential parts of being human. When a person writes, he or she often tries to express a personal and strongly-felt truth, exposing a fraction of his or her personality and risking refusal and rejection in return for a chance to reach an understanding with others. All of this goes through my mind when I think or talk about writing, so that a writing course then becomes more than a class, more than a subject.

Aside from my personal feelings about writing, there are my experiences in the writing program at M.I.T. As a freshman I took, more by accident than by anything else, a course called "Writing and Experience" which was aimed at getting students to write and respond to each other's work. This class provided an opportunity to know other freshmen and to air the gripes and frustrations that stemmed from the adjustment to being a freshman at M.I.T. I met students and instructors who formed a group of

friends with whom I have grown; I have come to respect them for their interest in my writing and for their abilities as writers.

Since that first course, I've taken a number of literature courses, ranging from a class on Hemingway, Fitzgerald, and Faulkner to one studying the various aspects of comedy. I have encountered other students with similar interests in writing, and their ideas have encouraged me to continue to write. Through this process of alternately being inspired by great works of literature and being frustrated by my own attempts, I now feel comfortable when I write. This ease of self-expression is important to me, and therefore my classroom experience in writing is valuable and well worth the time and effort.

Since I came to M.I.T., student interest in writing has increased tremendously. For example, twenty-eight people showed up for the first class in the writing workshop course in which I was the teaching assistant; the ideal working number is about twelve. Through persuasion and encouragement, the number was reduced to eighteen, but other courses and sections had to turn students away. I find this interest amazing at a school which until a few years ago had no standard writing program; even now, many M.I.T. faculty regard writing courses as "gut," or easy. The interest and talent for achieving a high level of writing quality exists at M.I.T., but whether the administrative support is there, I can't say. As a non-humanities major involved on the periphery of the writing program, I sense a desire by many students, regardless of field, to develop and express their creativity, and this pleases me. □

— To . . . meet the demand . . . for training and experience in writing as an art, in some cases as a profession, and more generally as a requisite of an educated citizen . . .; — To bring M.I.T. into contact with the large audience of educators in the humanities by fostering research into the process of teaching and learning writing."

If writing is a personal means of expression, then, the staff of the Writing Program believes, learning to write should also be a personal experience. No longer is there the authoritarian role of "the teacher" who imparts his or her knowledge upon pliable pupils. Now the theme is cooperation. The students write about what interests them — based on the presumption that if the subject is interesting to the writer, then the writer will make it understandable and interesting for the reader. Once a piece is written, the teacher does not pass judgment on it; rather, copies are passed out at class and the students themselves offer their own personal reactions. Ken Skier, '74, who is now a technical instructor with the Program, describes it this way: "The teacher doesn't 'lead' the discussions; he or she may even say little or nothing. The author listens, and learns how his or her words affect different people . . . you learn to write by writing,

listening to your readers, and rewriting."

And Mr. Skier believes that the need to communicate is the primary reason behind the high enrollment each year. "In fact," he says, "every section we teach has more students than we consider ideal." With courses that have so many students (approximately 15), grading each person could become difficult; but in the writing program, grading is decided by both the students and the teacher. "There is no single 'judge' of writing quality, says Mr. Skier. "Some students choose to be graded on the number of pages they write, other on how many articles, stories, or poems they complete."

But much more than learning how to write is happening at the Writing Program. Research on improving writing techniques based on technological aids — tape recorders and text-editor computer programs — is a topic of interest for Mr. Skier. Now he is attempting as well to interest other students in the psychological/linguistic/social relationship between talking and writing.

The Writing Program's goal is to "move the program into the Institute," says Professor Cumming. Both she and Mr. Skier are bringing writing to departments such as management and engineering, and other courses involving photography and the ar-

chitecture department are evolving from the Program. As the Program's proposal explains, writing can be "a new way for the Institute to fulfill its professed ambition to find new unities between the arts and technology, the humanities and science." But as Mr. Brown is quick to point out, "It'll take awhile; we're still in the planning stage." Professor Kaye would like to see the Program "reach out into the city," with courses for the whole community stemming from M.I.T.

One problem still exists in the midst of innovation and growing student interest: money. One former student, under the auspices of a foundation, contributed \$6,000 to the program, and the Sloan School of Management gave a \$12,150 grant for two courses pertaining to telecommunication — writing and television — and the equipment involved; but because the Writing Program's needs are constantly increasing, the Program is intensively exploring outside funding for its innovative teaching methods. The Program's staff is hopeful that *Freeing Writing*, a book about the learning experiences of those who first taught writing at M.I.T., will aid teachers and students outside M.I.T. to reach a method that will suit their needs. □

I am a writing major at M.I.T., and when people learn that the next question is obvious: "Then why are you at M.I.T.?"

If this question comes from an electrical engineering major, I know what he's thinking: that I'm an undergraduate who started school as an engineer but couldn't "hack it."

That's too easy an answer, and it probably isn't true for most writers here. People like myself do come to M.I.T. planning to major in the Department of Humanities (writing, music, literature, anthropology, history, and social inquiry). And then there are those who started taking writing classes for Humanities credit and found it worthwhile to add writing as a second major.

Actually, M.I.T. offers as much variety and quality in terms of its Humanities classes as many good liberal arts schools, and at the same time gives a solid scientific background even to those who don't major in science. That's one reason why I came: I just like science courses. One physics professor once berated me, stating his view that having Humanities majors at the Institute is unfair to people who are here for science or engineering because Humanities majors downgrade the "integrity of an institute of technology."

I simply don't agree. I think the writing program has the most exciting potential of all possible majors at M.I.T. As a relatively new choice for a major, Humanities is small; the staff — accessible to students and willing to try new teaching methods and courses — is compiling a flexible and alive program. There are intriguing combinations of communication media, such as "Writing

and Photography" and "Poetry and Photography." Even the "standard" writing classes are different from classes elsewhere: The discussion/communication setting creates an understanding rapport with others in the class that is unparalleled anywhere else.

Since Humanities is an undergraduate program, undergraduates have the added opportunity to be teaching assistants and that's a good way to learn more about the teachers and the educational process.

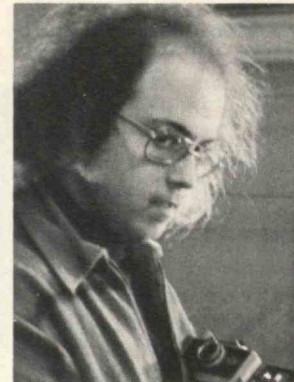
With all these advantages, why would anyone want to major in e. e. anyway?

"A Better Atmosphere for Learning . . ."

For a person like myself, interested in trying to master writing, M.I.T. was hard to ignore as a valid possibility when I was looking over what colleges to apply to. Compared to humanities-oriented schools, there seems a refreshingly down-to-earth attitude about "the arts" — probably a necessary attitude at basically a science school; but I don't know of any other school of science and technology with Humanities majors. Perhaps it's just a matter of discipline; but if the strict standards of science are applied in the arts, maybe that's the most important thing about M.I.T. humanities.

You may ask, How does the discipline from science affect writing? My answer is that this is a nonquestion, that it does not affect writing. I don't think writing requires any more discipline than any other thing you might want to learn. I just think science creates a better atmosphere for learning to write on anything. □

Why Come to M.I.T. to Study Writing? "A Refreshingly Down-to-Earth Attitude About 'the Arts'"



Lawrence J. Appleman, '76

Technology Review asked Lawrence J. Appleman, '76, of Brooklyn, New York, to write about the Writing Program. Larry is a writing and literature major and a teaching assistant in the Program; he is also Editor-in-Chief of Thursday, a student newspaper.

Help for Ailing Fish

Your guppy has suddenly fallen ill and seeing a vet is out of the question, so what can you do? Someone at the new M.I.T. Exotic Fish Society is bound to be able to help you.

That's right. Now there is a place at M.I.T. for collectors of those cold-blooded aquatic craniate vertebrates, whether an enthusiast needs help handling sick fish or wants to exchange some Jack Dempseys and Red Tiger Oscars for Red Devils and Baby Jewels.

Organized by William A. Vagt, '76, and Allen Strasberger, '75, the Exotic Fish Society, composed of 15 interested ichthyophiles, began holding monthly meetings last spring but was not recognized as an extracurricular activity until last fall. Now located in a Student Center basement room which features a picture-window display of a 125-gallon tank holding a dozen colorful fish, the Society offers general fish-care information, an aquarium loan service, live fish food raised by members, and the chance to meet other fish lovers.

Although the Society itself is loosely organized — officers were elected in March — its members anticipate holding guest lectures, building a library, and purchasing equipment to learn more about fish. But until then, they'll be satisfied with trading off information about Severums and catfish. □



Thinking that the only way to understand "the full complexities of a Shakespeare play" is to perform one, Murray J. K. Biggs, Assistant Professor of Literature, has gathered 16 students into the M.I.T. Shakespeare Ensemble. He warned them that the rehearsals would include "some exercises in speech and movement to help

'suit the action to the word, the word to the action,'" and said the first performance "would choose itself to fit whatever shape we take on as a team." That choice became "Twelfth Night" whose performances this past April were warmly acclaimed.

they have also put together a "pocket repertory" of scenes for informal presentation before Shakespeare classes at M.I.T. and elsewhere. It's "the only group in Boston dedicated to the extensive performance of Shakespeare's plays," says Professor Biggs.

The inaugural performance — on April 19 through 23 — was the comedy "Twelfth Night," played on a stage in the Sala de Puerto Rico "to emphasize the 'chamber' atmosphere of the play," said Professor

Biggs. There was special music composed by John Cook, Institute Organist, who has written at least a dozen scores to accompany Shakespeare productions at Stratford, Ontario, and there were enthusiastic audiences and reviewers. No coincidence that Shakespeare's birthday falls on April 23, and to celebrate that anniversary \$1 was added to the price of tickets for that night so the audience and cast could share a champagne toast to the great master during the intermission. □

To Learn Shakespeare You Must Perform It

Alumni Day May Set a Campus Record: Clambakes, Las Vegas, and a Japanese Tea

It was September when Murray J. K. Biggs, Assistant Professor of Literature, announced in the student arts newspaper *Monday* that he was starting a "Shakespeare Ensemble" at M.I.T. "I'm doing it," he wrote, "out of a growing discontent with the way Shakespeare is generally perceived, . . . the painful and fuzzy high-school memories" most students have of the playwright and his works.

The trouble, wrote Professor Biggs, is that most people study Shakespeare backwards: they read him, write something about him, expound on him in class, listen to a play on a record or see it on stage, participate in a live reading, and finally take part in a production. That's just backwards, thinks Professor Biggs. "The only way to understand the full complexities of a Shakespeare text is to do Shakespeare."

So Professor Biggs advertised this fall for students who might share his interest in an actor's view of Shakespeare. More than 70 responded, and from them 16 M.I.T. and Wellesley students have formed what they call the M.I.T. Shakespeare Ensemble. They'll present one play each term, and

pay by strengthening its hands and increasing its influence in every possible way . . ."

A few months more than 100 years later, lured by the centennial, the nation's bicentennial, a record number of on-campus reunions, and a change in schedule which puts Alumni Day and reunions nearly a week after the Institute's Commencement instead of almost on top of it, alumni were signing up in record numbers for rooms and tickets to a list of events ranging from Tech Night at the Pops to a Japanese tea ceremony in McCormick Hall.

It all begins with the downswing of Maes-

tro Arthur Fiedler's baton in Symphony Hall on Thursday evening, June 5.

A full day on June 6 at M.I.T.:

— Walter A. Rosenblith, Provost, and four colleagues on how the products of innovation in science, engineering, planning, and the social sciences work toward the solution of societal problems: Frank Press, Head of the Department of Earth and Planetary Sciences; Donald A. Schon, Ford Professor of Urban Studies; Robert M. Solow, Institute Professor (Economics); and Myron Tribus, Professor of Engineering and Director of the Center for Advanced Engineering Study, 9:15 a.m., Kresge Auditorium.

— Alumni assembly with Jerome B. Wiesner, President; Howard W. Johnson, Chairman of the Corporation; and officers of the Association and of the reunion classes, 11:30 a.m. in Kresge Auditorium.

— Lunch on the Kresge mall, 12:30 p.m.

— Memorial service in the M.I.T. Chapel, 1:15 p.m.

— Special presentations by every department and interdepartmental group at M.I.T. in two sessions from 2:30 to 3:30 and 3:45 to 4:45; every alumnus and guest will find some topic of interest or concern.

— Gala centennial reception in the Sala de Puerto Rico, 5 to 6:30 p.m.

Even as the Alumni Day program begins, members of nine classes will be moving into M.I.T. Houses on the campus for traditional reunions. That's more reunions, by far, than have ever before been held on the campus. Here is the list:

— Five-year Class of 1970 — MacGregor House

— Ten-year Class of 1965 — MacGregor House

— Fifteen-year Class of 1960, Burton House

— Twenty-five-year Class of 1950, Baker House

— Forty-year Class of 1935, Burton House

— Fifty-year Class of 1925, McCormick Hall

— Fifty-five-year Class of 1920, McCormick Hall

— Sixty-year Class of 1915, McCormick Hall

— Sixty-five year Class of 1910, McCormick Hall

Among the enticing events (in addition to that Japanese tea ceremony) on the various programs: receptions at the President's House, swimming-party-picnics at the Alumni Pool, dinner-dance at the Museum of Science, cruise and picnic at Georges Island, and "Las Vegas" night buffet.

Only four reunion classes will desert the campus for their festivities — the Class of 1955 to the Harbor View Inn at Edgartown, Martha's Vineyard (June 7-8), and three classes — 1945 (June 7-8), 1940 (June 7-8), and 1930 (June 4-5) — to the Chatham Bars Inn, Chatham.

The demand for tickets suggests a word of warning: readers who have yet to declare their intentions should do so at once. For information, write to Joseph J. Martori, Alumni Association, Room E19-439, M.I.T. □

Iran: A Gracious Host to Washington Alumni

Through the thick of a Washington, D.C., snowstorm (2 in. accumulation, but serious enough for that city) on February 4, 180 of M.I.T.'s area alumni responded to the invitation of His Excellency, Ardesir Zahedi, Ambassador of Iran, to a reception and dinner at the Iranian Embassy.

The Washington press corps thought it an important social coup. But those attending found a suggestion of more important things to come through an international collaboration in research and education.

The evening was arranged by the M.I.T. Club of Washington, and its success was assured by the unstinted efforts of the Club's principal officers — Kenneth F. Gordon, S.M. '60, President, and Mark Joseph, '64, Vice President for Programs. The Club's original announcement brought a response from 1,400 alumni and guests who wanted to attend; but the Embassy has capacity for only 180, so the Club officers had an opportunity to practice their own diplomacy by democratically paring the group down to 180.

The enthusiastic response to the invitation was not surprising. Iran, as a country with new-found wealth from vast oil reserves, is earnestly searching for the tech-

nology by which it can responsibly develop its resources and improve the quality of life of its people. What better place to seek counsel than M.I.T.?

In a 45-minute informal address to M.I.T. alumni, His Excellency, the Ambassador, described the historical development of Iran's foreign policy and emphasized the supportive relationship that the United States and his country have enjoyed. For example, when questioned by one alumnus as to the then-pending investment by Iran in Pan American Airways, the Ambassador responded that an investment would be made only if the move were approved by and would benefit the United States.

As to M.I.T.'s special involvement in Iran's affairs, the Ambassador hoped that the Institute, among other things, would assist in the development of Iran's technical university. M.I.T.'s President Jerome B. Wiesner, present as a special guest that evening, responded positively to the Ambassador's remarks by indicating that Iran and M.I.T. had begun serious talks about the development of programs that would be of interest to both parties. Shortly after the meeting, M.I.T.'s Dean of Engineering, Alfred A. H. Keil, and William F. Pounds, Dean of the Sloan School of Management, left for Iran to discuss cooperation in future academic and research ventures. The sense of growing friendship was unmistakable under the mirrored ceilings of the Imperial Embassy. — J.A.C.



Two attractions drew a capacity crowd of M.I.T. alumni to a reception at the Iranian Embassy in Washington on February 4: legendary hospitality, and

interest in the developing friendship between M.I.T. and Iran. (Photo: John Bowden, Washington Star-News)

A 340-lb. Wrestler Finds He's Still Number Two; But "All I Can Say Is, 'Murray, Watch Out!'"

Erland van Lidth de Jeude, '76

This report by M.I.T.'s top heavyweight wrestler was written for The Tech just after the author competed in the 1975 New England Intercollegiate Wrestling Tournament at Massachusetts Maritime Academy on February 22.

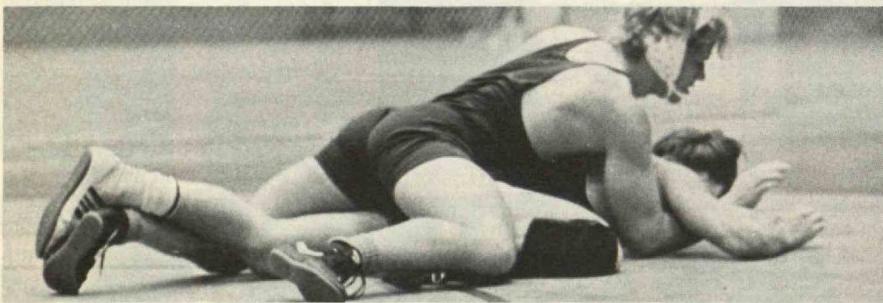
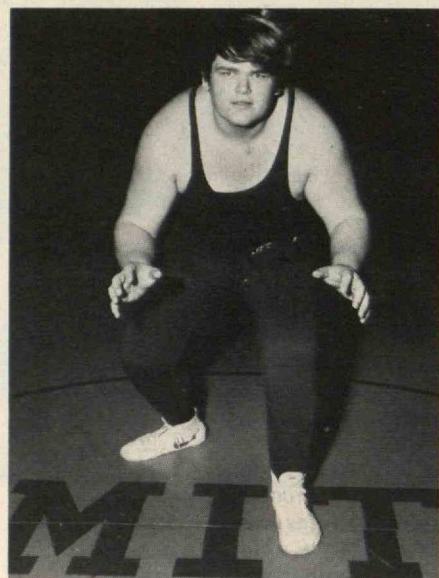
We knew that the heavyweight division in the New England Wrestling Tournament would be tough this year. Last year's top four placewinners were back and wrestling with another year's experience. They were, in the order they finished last year, Jim Murray of Coast Guard (220 lbs.), myself (340 lbs.), Tim Smith of Springfield (245 lbs.), and Harry Jackson of Williams (250 lbs.).

Tim Smith had been the New England champ two years ago, but last year I beat him in the semifinals, and he placed third. I met him again this year in the semis and killed him [figuratively] 10-2, and he finished in fourth place this year. His placing first,

third, and then fourth in three successive years gives a good indication of how much heavyweight wrestling has improved in New England in these years.

I had lost to Jim Murray 3-0 in the finals last year and 2-0 in a dual meet this year. Since those losses, though, I had been working out with Fred Andre, who had wrestled for M.I.T. and in 1968 had been the New England heavyweight champion and placed fourth in the Nationals. I felt that I had learned much from him. As I went into the finals I was confident that I could win the title this year.

It wasn't enough, though, as Murray outwrestled me in the finals this year, proving to me that I was still only number two. It was disappointing, but I have wrestled for only three years and finishing second beats finishing third. I still have another year to improve, so all I can say is, "Murray, watch out!" □



The high point of the winter sports season came when the M.I.T. fencing team won the Intercollegiate Fencing Association foil championship and kept the "Little Iron Man" trophy. The other pictures show track captain Gary R. Wilkes, '75, finishing a team victory over Bates in the one-mile relay, forward Peter L. Jackson, '76, in

basketball action against Bowdoin, and wrestler Loren Dessonville, '75, with the advantage on a Springfield College opponent early in a bout which he eventually lost. (Photos: Jet Photographers, Mark H. James, '78, Edward J. McCabe, '75, and David A. Schaller, '78)

Sports: The Fencers Lead the Pack; A Good Season Except in the Scores

Measured by the wins-and-losses columns, the winter sports season of 1974-75 was hardly less than a disaster. But that's not really the way to measure M.I.T. athletics, and the appropriate reckoning — numbers of games played, numbers of students playing them, and the spirit of competition and fun in which the whole is conducted — makes this year's season very strong by any comparison.

The outstanding intercollegiate performance was that of the fencing team, which left the du Pont Gymnasium on March 1 with its sixth straight New England intercollegiate title and a week later successfully defended its national foil championship. The foil championship kept in Cambridge the "Little Iron Man," oldest of all intercollegiate athletic trophies.

Malcolm C. Smith, '78, won all 11 bouts of the foil competition in the nationals, and Arlie G. Sterling, '77, did almost as well; in all, the team piled up 24 wins out of a possible 33. Individual winners in the New En-

gland championships included C. Douglas Park, '75, Richard W. Reimer, '77, and Holt L. Farley, '75. Going into the New England competition, the fencing team was 14-2 for the regular season, having won 13 straight.

"Even When You Lose, Athletics Are More Fun"

Traveling to the Massachusetts Maritime Academy for the New England Intercollegiate Wrestling Tournament, Erland van Lidth de Jeude, '75, knew the competition "would be tough this year." The fifth place they won was more than the team expected, and it left them ranked eighth in New England.

Three weeks later Mr. van Lidth de Jeude went on to become the second M.I.T. wrestler in as many years to reach the status of All-American by finishing sixth in the N.C.A.A. Division III National Competition; he also left John Carroll University in Cleveland with a trophy for obtaining the greatest number of falls in the least amount of time; he pinned his opponent in the first period of each of the three bouts that he won. In all, M.I.T. was 22nd in a field of 60 schools at the N.C.A.A. Division III meet.

Other notable winter sports highlights:

— Gary R. Wilkes, '75, placed fourth in the 50-yd. dash at the New England Collegiate Track and Field Championships, and Richard K. Okine, '77, was fifth in the 50-yard hurdles.

— After a disappointing 2-8 regular season, the gymnasts came up with a creditable fifth in the New England championships at Plymouth State College, N.H.

— Though his team finished the season 9-16, basketball captain Alan G. Epstein, '75, ended his season and career just as any basketball player would want to. He hit his last nine shots from the floor and finished against R.P.I. with 20 points for the night; during his collegiate career he had scored a total of 508 points (7.2 per game). His 376 career assists are an M.I.T. record.

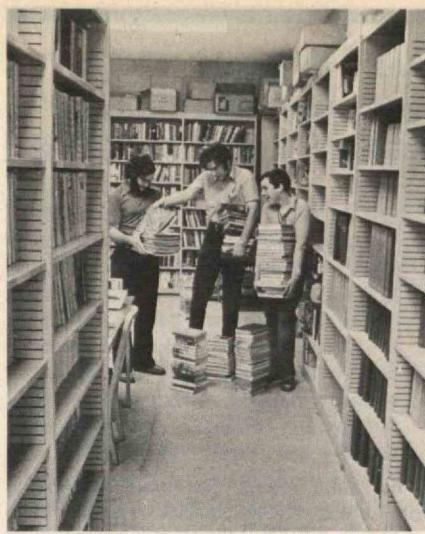
Campbell M. Lange, '76, is now third on the all-time-M.I.T.-career basketball scoring list with 1,301 points — 22.5 per game. And Peter L. Jackson, '76, raised his career total to 954 points; he will be M.I.T.'s seventh 1,000-point scorer early next year.

— Peter N. Horowitz, '76, jumped to a hill record of 82 ft. at Rindge, N.H., as the M.I.T. ski team placed third in the Franklin Pierce winter carnival.

— George H. Braun, '75, captain of lacrosse, was a consistent winner of the 600-yd. run during the winter. He'll receive his degree in ocean engineering next month, but he's not sure about an engineering career.

— What's the matter with engineering? asked Barry Cadigan of the *Boston Globe*'s sports staff.

"There's not much fun in engineering," said Mr. Braun, "just a lot of numbers and equations. Even when you lose, athletics are a lot more fun." So Mr. Braun will go on to Springfield College for a graduate degree — and probably a coaching career. □



This past fall, the Science Fiction Society Library grew so large that the Society had to tear down a wall in order to expand. Three members, (from left to right) Seth I. Breidbart, a Harvard cross-registrant graduate student, Jack H. Stevens, '75, and Earl T. Cohen, '78, helped to move some of the Library's 20,000 books from one room to the other. It may be the nation's largest accessible collection of science fiction.

S.F.S.: Where Fiction Is Bigger Than Truth

You know that M.I.T. is a foremost leader in science and technology. Surprising, perhaps, that here is probably the largest U.S. collection of science fiction open to the public.

Housed in not one, but two rooms on the fourth floor of the Student Center, the Science Fiction Society Library is "dwarfed" by only two or three private collections; it almost surely holds first place in the accessible-collection category with 20,000 science fiction titles in hardcover, paperback, and magazine formats; there are 3,000 foreign-language magazines in French, German, Italian, and Swedish. It is also the official New England depository for the Science Fiction Writers Association.

Guy J. Consolmagno, '74, a Society member, told *Tech Talk* that "there is a lot of rare stuff" in the collection — such as the first 1923 issue of *Wierd Tales* magazine and an original, unpublished manuscript by John W. Campbell, Jr., '33, former editor of *Astounding Science Fiction* and *Analog* magazines, the personal sets of which he donated to the library. In fact, these magazines have just been microfilmed by Xerox University Microfilms (Ann Arbor, Mich.), who informed the Society that theirs was the first complete set they could find.

Founded in 1950, the Society is the oldest group of its kind on any U.S. campus; it op-

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erates on a budget of more than \$3,000, two-thirds of which comes from the dues of its 300 members, the other third from the Student Activities Financial Board and the M.I.T. Libraries.

Among recent visitors have been Hal Clement, reputedly the best of the "hard science," or technical, science fiction writers; Theodore Sturgeon, who mentioned the library in his *Galaxy Science Fiction* magazine column; and Isaac Asimov, a frequent borrower while he resided in Boston. But whether you're a famous author or you just want to relax in a comfortable chair with a good book, the Library doors are always open. □

People

Threefold are the ways in which the Head of the Humanities Department sees his new charge developing. The appointee is Bruce Mazlish, Professor of History, and the three lines of development are:

- To explore the ways in which the Humanities Department can establish "firmer links with other departments and schools."
- To explore how the component parts of the Department can come together into "a first-class state."
- To explore how the component parts of the Department can best contribute to the Institute's broad educational goals.

The first priority, says Professor Mazlish, is to work with the Committee on the Humanities, Arts, and Social Sciences Requirement to realize the full potential of the new undergraduate "humanities" program approved by the faculty last spring (see June 1974, pp. 70-71). "We have to see the result of the present changes before we can make new plans," says Professor Mazlish, and the Committee will have to supervise these. One result, thinks Professor Mazlish, will be "tightening the humanistic side of the Department."

Professor Mazlish succeeds Harold J. Hanham, Professor of History and Political Science, who had been until last fall Acting Head since becoming Dean of the School of Humanities and Social Science two years ago; Professor Mazlish was named Acting Head effective in September.

Professor Mazlish first came to M.I.T. to teach history in 1950, after three years on the staff at the University of Maine and one

at his *alma mater*, Columbia University, from which he holds B.A. (1944), M.A. (1947), and Ph.D. (1955) degrees. He was Director of the American School in Madrid from 1953 to 1955 and then returned to M.I.T. where he became Professor of History and Chairman of the History Section in the Department (for five years) in 1965.

Professor Mazlish is co-author with Jacob Bronowski of *The Western Intellectual Tradition* (1960) and author of *The Railroad and the Space Program* (1965), *The Riddle of History* (1966), and *In Search of Nixon: A Psychohistorical Inquiry* (1972). His latest book, just published, is a psychohistorical study, *James and John Stuart Mill: Father and Son in the 19th Century*. □

Long Search Ends with a Princeton Librarian



Jay K. Lucker, who has been since 1968 Associate University Librarian at Princeton, will be new Director of Libraries at M.I.T. He'll succeed Natalie N. Nicholson, whose retirement from more than 30 years of work in library administration will become effective in July.

Mr. Lucker's selection culminates a long search which in a sense began with the retirement of Professor William N. Locke in 1972; Miss Nicholson was first Acting Director and then (March, 1973) Director of Libraries while Walter A. Rosenblith, Provost, and an *ad hoc* advisory committee sought a long-term new director from among more than 100 of the nation's most qualified professional librarians.

Running the M.I.T. Libraries is a big job: The system, including all school and departmental libraries, reading rooms, and document rooms in many interdepartmental laboratories and centers, comprises some 1.5 million volumes and periodicals. The operating budget is just under \$3 million.

But Professor Lucker will be no stranger to the problems which are implied. His primary responsibilities at Princeton have included budget development, space planning, personnel, and the overall internal management of the University's library. He comes to the Institute with a pledge "to see that M.I.T. maintains a library system worthy of the Institute's position."

Professor Lucker studied at C.U.N.Y. (Brooklyn College) and Columbia University, from whose Graduate School of Library Service he holds the M.S. (1952) degree. He has worked at the Brooklyn College Library and went to Princeton in 1959 from the New York Public Library to be Assistant University Librarian for Science and Technology.

Miss Nicholson came to M.I.T. in 1954 as Reference Librarian, and she was Associate Director of Libraries from 1958 to 1972. □

A Rare Bargain in Nuclear Research

When a fundamental particle coming from an accelerator at almost the speed of light strikes a proton or neutron, the result is a shower of nuclear debris; both particles in the collision shatter into many smaller (or less energetic) particles.

But what happens if the target proton or neutron is buried inside a uranium nucleus, surrounded by 200 other similar particles? A cascade of shattered debris, high-speed particles colliding with others to create an increasing shower? Not so.

The answer is hardly noteworthy; cosmic-ray physicists watching events as high-energy cosmic-ray particles arrive at the earth's atmosphere from space had already concluded that no self-generating cascade occurs, and the experiment simply provided confirmation.

But the work by Wit Busza, Associate Professor of Physics, has attracted local attention for its unique method and low cost.

Half-a-million dollars is not unusual for a high-energy physics experiment. But Dr. Busza had only \$10,000; how could he count the collision products? Consider the curious properties of ordinary plexiglass: A particle travelling faster than light through plexiglass creates a shock wave of light much as a supersonic aircraft creates a shock wave of sound in the air. The amount of light is independent of speed; if they're travelling fast enough to make light at all, two particles make twice as much light as

one. So if you can measure the amount of light in the plexiglass you are in fact measuring the number of particles — which is what Dr. Busza wanted to know.

In the 400-B.e.v. proton accelerator at the Fermi National Accelerator Laboratory near Chicago, Dr. Busza's plexiglass counter confirmed that a single collision led to the same amount of light — no matter what material it occurred in. No big cascade in a heavy, proton-rich medium. Dr. Busza's conclusion is that new particles are born in such collisions only long after the particles collide with the nuclei — a new, if tiny, hole filled in the jig-saw-puzzle of high-energy interactions. □

of an object as it moves with respect to the observer's frame of reference.

Acting Head of Philosophy

Sylvain Bromberger, Professor of Philosophy, is nearing the end of six months' service as Acting Head of the Department of Philosophy during the absence on sabbatical leave of Professor Richard L. Cartwright.

Professor Bromberger, whose special interest is the philosophy of language and other problems related to semantics, came to M.I.T. in 1965 as Research Associate in the Department of Humanities. He joined the faculty in 1966. His degrees are from Columbia (A.B. 1948) and Harvard (Ph.D. 1961), and his previous teaching assignments have been at Princeton and the University of Chicago. □

The New Arthur and Ruth Sloan Professor

Ithiel D. Pool, who has made distinguished contributions in the field of communications policy as a member of the M.I.T. faculty since 1952, has been named the Arthur and Ruth Sloan Professor of Political Science.

Professor Pool is the first to hold the Sloan chair, which was established in 1961 by Arthur W. Sloan and his wife, Ruth C. Sloan; heretofore, portions of the Sloan gift have been used for career development among younger members of the political science faculty whose research interests are in African affairs.

In contrast, Professor Pool is a national authority on such issues in communications policy as cable television, citizen participation, privacy and data banks, and the effects of television on children. He will continue his work on the social and political impacts of communications technology under the Sloan professorship.

Arthur Sloan is a noted chemist, former

The New Head of Humanities Calls for More "Intellectual Vigor and Excitement"; Snapping a Finger Won't Make an Engineer a Humanist

What should be the role of the humanities at M.I.T.? A prime question for the new Head of the Department (see left), and it was the first question which *The Tech* asked Professor Bruce Mazlish shortly after his selection was announced early this spring. His answer, and his response to some other questions put by Leon H. Tatevossian, '78, follow — published here by permission of Mr. Tatevossian and *The Tech*:

Professor Mazlish: I think the role of the Department should be plural, a number of roles. One role is quite obviously to offer the best possible work in humanities to students who are mainly majoring in science or technology. And later on we might want to talk about what the word "humanities" means, because it can cover a multitude of sins and virtues. Then it seems to me that the Department also has a role in supplying another perspective to the scientific or technological one for everyone at the Institute, the so-called humanist way of looking at ideas which tends to delight in ambiguities and ambivalences instead of certain truths.

Another role is to allow students who decide that the scientific or technological path is not for them, and yet don't want to transfer out of M.I.T., to remain here but to major in humanities.

Another role, and one that has been increasingly important in the last year or so and must be even more so in the future, is for the Department to become integrated into the full intellectual life and work of the Institute, to become involved with the people in engineering and science in trying to understand problems that are related to the creation of a new kind of world by science and technology. I think that the engineers and scientists are very aware of the way in which value questions, social context, and historical context are integral now to their own work, and I think both sides have a great deal to offer to each other; in some ways in the future the only way you'll be able to do good science or technology is by having a very keen awareness of the humanistic and social science component.

The Tech: Has there been a major increase in the numbers who come to M.I.T. as humanities majors?

Professor Mazlish: No, I don't think that has taken place. MIT is obvi-

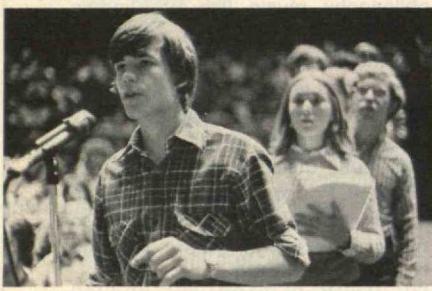
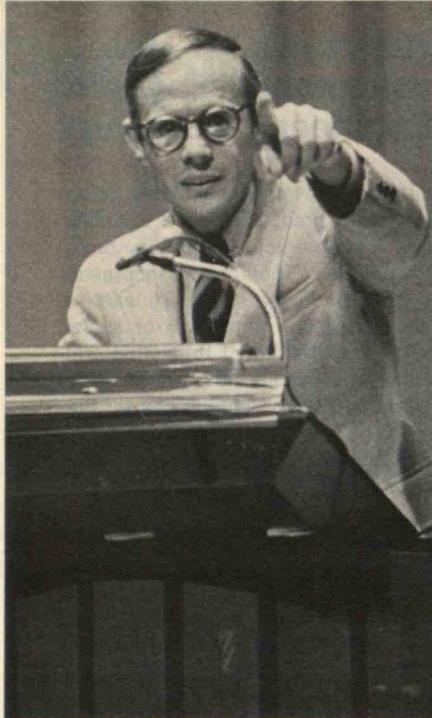
ously, for the foreseeable future, going to remain predominately a scientific and technological institution, but I think there is room for an increased number of students who will want to emphasize the humanistic or social science side, and I think this will come about in the next two or three years, but I don't think it has for the moment.

The Tech: Do you foresee any changes in the Department in the near future?

Professor Mazlish: I'd like to use that question to make a point about humanities. The word humanities is really somewhat ambiguous. There are certain disciplines that are normally covered under that term. Some of the subjects traditionally defined under the term are history, literature, philosophy, music, fine arts, linguistics, sociology, in other words, an enormous range. The Department of Humanities embraces four major disciplines or fields: literature, history, music and archaeology/anthropology, and these disciplines are extremely different. For some involved in teaching, literature is more a matter of higher criticism; for others, literature is politics; for others, it's primarily a question of literary history.

Then we have a number of other programs; a fairly vigorous writing program has been emerging, and the Music Section is becoming more and more involved in a program throughout the Institute. Then we have the Cambridge Humanities Seminar, we have Crossroads, possibilities in American Studies or Russian Studies, and several different majors. So when you say what's happening with humanities, that's a great deal.

I think we need to offer opportunities in music and writing to more people. We have to get as much clarity about what we're doing in literature or history as we possibly can, and make clear to the students the different ways in which these subjects are conceived. I'm trying to stimulate a certain amount of thought about this among my colleagues. I've asked one of my colleagues to set up some colloquia on the subject of "What is History?" "What is literature?" "What are the humanities?" and their role at M.I.T. I would like to see a great deal more intellectual vigor and excitement demonstrated in the Department and communicated to the students. □



"The poll was not very scientific," John Dean told an M.I.T. audience at Kresge in February, "but I decided to telephone randomly selected Los Angeles residents and anonymously ask them what they thought Watergate meant. The words 'corruption tied in with power' were used by about 80 per cent."

Mr. Dean stressed that in the atmosphere of the Nixon White House, where there was no check on illegal activities, Watergate was inevitable. He explained that Watergate was certainly the worst, but also probably the best experience of his life. Although the investigation and prison term were extremely unpleasant for him and his family, he said, he learned things about himself and his government that he should have known. "I'm not as quick to jump to judgement about others as I once was."

Although he is troubled about commercializing on Watergate, Mr. Dean said that because he was presently in debt, he could not afford to lecture for free and didn't know what else to do. The Undergraduate Association and Lecture Series Committee paid him \$3500 for the lecture.

More than 90 minutes were spent answering questions from the audience. (Photos: Owen D. Franken, '68, from Stock, Boston)

Chairman of the Board and Executive Vice President of the Atlantic Research Corp.; Ruth Sloan is a distinguished historian, an expert on African affairs.

Professor Pool studied at the University of Chicago and taught at Stanford University before coming to the Institute. His career in political science has been widely varied, including work on political philosophy and public policy, the use of quantitative methods and computer technology in political research, and social characteristics of political elites. He was Head of the Political Science Section in the Department of Economics and Social Science when the Section was designated a Department, and he became Head of the Department at that time. Shortly thereafter it was designated by a national panel of deans and department heads as providing "the best instruction in political science" in America. □

could absorb a tremendous amount of information, preferably from paper, not from an arguing group standing in front of him. He enjoyed his isolation. There was a great deal of performing; you were given what was best for you to see. I remember when some students were coming to meet the President, I was surprised when Nixon told me to be there. He said we were going to talk to them about the budget — and I knew nothing about the budget. When they came in, Nixon made some comment about how young people had a voice in the administration. I later phoned Haldeman and asked him why I was called into that meeting. "Well, John," he said, "the President thinks you look like a hippy."

Student: How could you be so stupid as to think that the administration could use the I.R.S. to make trouble for political enemies?

Dean: Nixon seemed to think the I.R.S. had always been used for that.

Student: What is a day in prison like?

Dean: I never saw any tennis courts. . . . I spent most of the time in a little room, could not walk in the small yard, was allowed only two personal calls per week and visiting privileges on weekends. I felt entirely helpless — the loss of freedom was the hardest to take.

Student: Do you see politics in your future, and why not?

Dean: That reminds me of when I was in Canada and a newsman shoved a microphone in my face and asked if I was lecturing in order to run for President. "Are you kidding?" I said. "Why, are you disillusioned with politics?" he responded. I told him he doesn't understand how things work here. (laughter)

Student: What do you think of lesser sentences for white-collar crime?

Dean: I know of a young person who was convicted of the possession of 10 oz. of marijuana, and he got ten years. I got four months. That's not justice. (applause) I hope some day you can say John Dean said he was going to do something about prison reform — and he did.

Scene II: Kresge, 10:15 p.m. Dean is leaving the stage. The audience's attitude seems to have reversed. The applause is warm and some people are standing.

A "Human" Response to R.O.T.C. — a "Nice Change"

Two career military officers have taken their places as Directors of R.O.T.C. programs at M.I.T.:

— Colonel John S. Kark, U.S.A., is Visiting Professor of Military Science and Director of the Office of Military Science.

— Lieutenant Colonel Larry Schwartzman, U.S.A.F., holds similar titles with respect to



Two military officers have arrived at M.I.T. as Directors of R.O.T.C. programs: Colonel John S. Kark (left), U.S.A., has served in the Army in Europe and the Far East, and Lieutenant Colonel Larry Schwartzman, U.S.A.F., is an electrical engineer with broad experience in the U.S. Air Force.

Aerospace Studies.

Their tours at M.I.T. will continue until the summer of 1977.

What kind of environment will they find in these two-plus years? Commander Kenneth I. Bergstrom, U.S.N., who came to M.I.T. four years ago and so is an "old hand" with R.O.T.C. here, thinks they will like it. "When I arrived in Cambridge it was a very uncomfortable atmosphere," Commander Bergstrom told Peter Mancusi of the *Boston Globe* this winter. That was while the Vietnam fighting was still under way, while student protests focused on all kinds of military apparatus.

"Today, it's almost as though you're not seen. Students are either indifferent or respond to you on a human level," Commander Bergstrom said. "It's a nice change."

Colonel Kark came to M.I.T. from an assignment in foreign languages at the U.S. Military Academy; he speaks five languages and has degrees in political science and European history. Colonel Schwartzman studied electrical engineering at the University of Michigan and Auburn University, and he has attended several service schools — including the Air Command and Staff College and the Air War College. □

contributions to the gaseous diffusion process for separation of fissionable uranium isotopes" . . . to **Murray A. Geisler**, Visiting Professor of Management Science at M.I.T., the position of Fellow of the American Statistical Association . . . to **Thomas W. Lambe**, Edmund K. Turner Professor of Civil Engineering, the Karl Terzaghi Award of the American Society of Civil Engineers in recognition of his "outstanding contributions to knowledge in the fields of soil mechanics, subsurface and earthwork engineering, and subsurface and earthwork construction" . . . to **Walter J. Smith**, '28, Honorary Membership in the American Society for Testing and Materials "for his inspired leadership in the study and practice of the sampling, analysis and control of atmospheric pollution and exemplary service and dedication to the principles of the voluntary consensus standards system through A.S.T.M." . . . to **J. Herbert Hollomon**, Director of the M.I.T. Center for Policy Alternatives and Institute Professor of Engineering, election to the Royal Swedish Academy of Engineering.

Gordon E. Holbrook, '39, and **George Rosen**, '37, shared the Goddard Award of the American Institute of Aeronautics and Astronautics "for joint leadership and technical contributions in pioneering the development and production of widely-used turbo-propeller propulsion systems" . . . to **Rocco A. Petrone**, '32, the Louis W. Hill Space Transportation Award of the American Institute of Aeronautics and Astronautics . . . to **E. Alfred Picardi**, '44, the 1975 T.R. Higgins Lectureship Award of the American Institute of Steel Construction . . . to **Walter H. Stockmayer**, '35, the 1975 American Physical Society High Polymer Physics Prize of the Ford Motor Company . . . to **Herbert R. Stewart**, '24, the William M. Habirshaw Award of the Institute of Electrical and Electronics Engineers for contributions "to transmission systems analysis and design, particularly protection, stability and control" . . . to **Eugene I. Gordon**, '57 Ph.D., the Vladimir K. Zworykin Award of the I.E.E.E. "for the invention and leadership in the development of the silicon target camera tube, and in the extension of electronic television into new application" . . . to **Paul A. Samuelson**, Institute Professor of Economics, an honorary Doctor of Laws degree at the mid-year Commencement of the University of Southern California.

Insurance Company of Vermont . . . **James H. Williams**, Jr., '67, Esther and Harold E. Edgerton Associate Professor of Mechanical Engineering at M.I.T., was chosen to complete the first Faculty Research Participation Program sponsored by the National Science Foundation . . . **Jerome B. Wiesner**, President of M.I.T., is a member of the newly formed American Committee on U.S.-Soviet Relations whose aim is the support of the "present trend toward the improvement of American-Soviet relations" . . . **Robert Seamans**, Sc.D. '51, former Air Force Secretary and N.A.S.A. official, appointed by President Ford to head of the new Energy Research and Development Agency. . . . **William S. Widnall**, '59, has joined the staff of the House Science and Astronautics Committee as A.I.A.A.'s first Congressional Fellow.

Appointments: Rising in the World of Business

Harold L. Smith, Jr., Ph.D. '39, elected Vice President of Eastman Kodak Co. and promoted to General Manager of the Kodak Park Division . . . **Lamar Washington**, Jr., '56, General Manager of the Innovation Coop, M.I.T. Innovation Center . . . **Daniel F. Blossey**, '64, Manager, Exploratory Imaging Area, for Xerox Corporation's Joseph C. Wilson Center for Technology . . . **H. Edward Marvill**, '31, Vice President-Underwriting, of Philadelphia Manufacturers Mutual Insurance Co. . . . **Samuel R. Fryer**, Jr., '59, Manager of Chemicals, Skelly Oil Co., with responsibility for coordinating operations of its chemical subsidiaries . . . **Donald J. Atwood**, '48, General Manager of the Delco Electronics Division, General Motors Corp. . . . **David A. Willis**, '60, Supervising Engineer in the Process Engineering Division of Standard

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Individuals Noteworthy

Kudos: Honors, Awards, and Citations

To **Manson Benedict**, Ph.D. '35, Institute Professor Emeritus and Professor of Nuclear Engineering, the John Fritz Medal for 1975 "for his outstanding versatility and impressive breadth in the chemical and nuclear engineering fields, especially for his

Counselors: Officers, Directors, and Advisors

Robert A. Sherman, '55 S.M., to the University of Rochester Board of Trustees . . . **Janet S. Perkins**, '52 Ph.D., to Chairman of the Northeastern Section of the American Chemical Society . . . **Ernest R. Gilmont, Gunness**, '36 Sc.D., to the Board of Directors, Champion International . . . **Thomas F. Jones, Jr.**, '52 Sc.D., Visiting Professor of Engineering and Education, to the Board of Directors of I.E.E.E. . . . **John Lawrence**, '32, and **Robert S. Gillette**, '36, were reelected Directors of National Life

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Oil's Pascagoula Refinery . . . **Richard M. Osgood**, S.M. '59, Vice President-Business Development for the Electronic Components Group of GTE Sylvania, Inc., a subsidiary of General Telephone and Electronics Corp. . . . **Robert L. Woodall**, S.M. '65, formerly Manager of Industrial Marketing, to Manager of Market Research, Dravo Corp. . . . **Robert A. Cross**, President and General Manager of Romicom, Inc. . . . **Virgil A. Minch**, S.M. '49, Vice President and Head of the Project Group, Atlanta Division, Stanley Consultants, Inc. . . . **A. Thomas Guertin**, Ph.D. '60, Technical Manager for color pigments, in the Pigments Division of American Cyanamid Co.

John L. Asinari, 1954-1975

During the early morning hours of a spring day, the hitchhiking attempt of two M.I.T. students resulted in one student being shot, stabbed, and beaten to death and the other sustaining multiple stabwound injuries, in what is believed to be the most vicious homicide case ever in Boston.

President Jerome B. Wiesner described the fatal attack as "a terrible tragedy, a senseless and irrational act of wanton violence."

"All of us at MIT share with Mr. Asinari's parents, his family and his friends a sense of shock and deep sorrow at the loss of this young life," President Wiesner said.

On March 21, the Friday night spring vacation began, two students, Robert D. Moses, '75, and the late John L. Asinari, '76, went to a Kenmore Square club and later to a pizza house. On their way back to the Institute, they decided to "thumb" a ride across the Harvard Bridge, Mr. Moses told the Boston Police Homicide Unit. But the car they entered turned onto Back Street, a small street parallel to Storrow Drive and proceeded through Everett, Chelsea, and the South End. After the car's four occupants demanded the students' wallets, the men began to stab and beat them; one assailant also shot at them, hitting Mr. Moses in the arm — an arm raised to his face which saved his life.

The final stop was South Boston where Mr. Asinari opened the door and pushed his friend out ahead of him. Mr. Asinari failed to elude the assailants, who caught him and continued their attack. By the time police officers, notified by neighbors who heard screaming, had rushed the two students to Boston City Hospital, it was too late; Mr. Asinari died an hour later. Mr. Moses was seriously injured but was reported in stable condition as this is being written.

Messrs. Asinari and Moses, both straight-A pre-medical students from Boston, were former roommates. □

The Asinari Memorial Scholarship

High school colleagues and his undergraduate friends at M.I.T. have joined to honor the memory of John L. Asinari, '76 (see left), by creating the Asinari Memorial Scholarship Fund. From it will come a scholarship each year for a senior in Arlington (Mass.) High School who is planning a pre-medical career, the selection to be made by Mr. Asinari's parents in counsel with faculty in the school.

As this is written, at least \$700 has been contributed to the fund by M.I.T. students and faculty who knew and respected Mr. Asinari, and Arlington High School students had planned a "bike-athon" to add more funds. Mr. and Mrs. Asinari will themselves sponsor the first scholarship award, to be made for 1975-76. Readers of the Review may send contributions for the Asinari Memorial Scholarship to the Arlington office of the Coolidge Bank and Trust Co., 635 Massachusetts Ave., Arlington, Mass., 02174; or to Nino Pedrelli, '78, at 46 Lakehill Ave., Arlington.

"Asinari": He Lived Life to the Fullest

He was born in Boston, a city for which he cared so much that he took great pride in his broad Bostonian accent, while others tried to conceal theirs. He was John L. Asinari, '76, a man who did everything to the fullest, be it rowing, studying, or working toward an ambition by helping others.

"Asinari." We first met at the boathouse last summer as oarsman and coxswain. He had been a member of the 1972-73 freshman heavyweight squad, but a knee injury forced him to give up crew for lacrosse. Still, he continued to row for pleasure if not for competition, contributing his stamina and spirit to our informal summer team. Anything that involved energy and life involved "Asinari."

He was drawn to Boston for its bustling urban culture; he was in no rush to graduate early in order to leave his hometown. An only child, he would often spend the weekend with his parents and grandmother in

nearby Arlington. Being a "Brighton girl" — as he called me — I was fated to meet "Asinari" almost everywhere I went this past year. And when I did, we'd usually discuss our mutual experiences from our Catholic childhoods and our mutual friends from Boston high schools.

People also played an important role in "Asinari's" life. No matter where he was, he was sure to befriend people; no matter how busy he was, he had time to joke with his friends or listen to their problems. And he never left without saying, "See you later," and making good that promise.

But "Asinari's" attraction to life was not a passing infatuation. He wanted to become a doctor and had excellent qualifications: the biological knowledge, an easy-going personality, and, most of all, the desire to help others. Ironic, isn't it, that the things that "Asinari" loved most laid that desire to rest. — C.C.S.

Fred W. Goldthwait, 1882-1975



Fred W. Goldthwait, '05, who had been active in alumni affairs since graduation from the Institute and Secretary of his Class since its 30th reunion in 1935, died on February 11 in Laconia, N.H.

Mr. Goldthwait spent most of his business life as President of the Duro Pump Co., which he joined in 1908; he was also the Company's Sales and Hydraulic Engineer for much of that time. Earlier he had been associated with the United Shoe Machinery Co. and Lanston Monotype Machine Co. He retired in 1958, moving then from Melrose, Mass., to Center Sandwich, N.H.

Between 1906 and 1974 Mr. Goldthwait attended every Alumni Day at M.I.T. save one, which he missed on account of a seri-

ous illness of his wife. He was a 50-year member of the National Grange and the Masons, and he was a charter member of the Sandwich Town Club whose members adopted a special resolution recording his "faithful, dedicated service" at the time of his death.

William D. Coolidge, 1873-1975



William D. Coolidge, '96, a distinguished inventor and industrial scientist who was M.I.T.'s second oldest alumnus, died at his home in Schenectady, N.Y., on February 3. He was 101 years old.

His long life was "a triumph of the human spirit in search of ways to help human society," said Reginald H. Jones, Chairman of the Board of General Electric Co., which Dr.

Coolidge had served since 1905. "No scientist in history has ever done more to bring light and better health to mankind."

Dr. Coolidge's greatest contribution was the design of a radically new type of X-ray tube with a predetermined and accurately controlled output. The "hot cathode" or Coolidge tube became the prototype of all modern X-ray tubes used in medicine.

He was born on a seven-acre farm in Hudson, Mass., on October 23, 1873. After graduation from M.I.T. in physical chemistry and electrical engineering, he served for a year as assistant in physics here, then continued his studies in Germany, where in 1899 he received his Ph.D. (summa cum laude) from the University of Leipzig. He then returned to M.I.T., first as an Instructor and later as Assistant Professor of Physical-Chemical Research.

It was in 1905 that Dr. Coolidge joined the research staff of General Electric Co. to begin experiments to make tungsten more ductile (existing lamp filaments were brittle and short lived). After two years of intensive research he was able to draw tungsten into fine wires as strong as steel and thin enough to be used as lamp filaments.

Large-scale production of ductile tungsten wire of any desired diameter was a commercial reality after two more years of research. A patent on the process for making ductile tungsten was granted to Dr. Coolidge in 1913, and it soon formed the

base of other discoveries. Today, it is still the filament material in billions of incandescent electric lamps throughout the world.

In World War I, Coolidge developed a portable X-ray generator for equipment needed at the front. A further contribution to military technology was the development of the first successful submarine detector which, under favorable conditions, could detect and locate a submerged craft at a distance of about two miles.

In 1932, Dr. Coolidge became Director of the G.E. Research Laboratories and in 1940 he became Vice President and Director of Research. A year later he was chosen by President Franklin D. Roosevelt to serve on a committee of six to evaluate the military importance of research on uranium. They recommended that the research be pushed vigorously.

Dr. Coolidge retired from G. E. in 1944, having been awarded 83 patents for pioneering work. Dr. Coolidge was to have been inducted into the National Inventors Hall of Fame in Arlington, Va., just five days after his death.

Dr. Coolidge was a Term Member of the M.I.T. Corporation from 1930 to 1935, and he maintained a lively interest in his *alma mater* until long after his retirement. He was widely honored by professional societies throughout the world, and he was a charter member of the National Inventors Council of the U.S. Department of Commerce. □

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Deceased

- William D. Coolidge, '96; February, 1975;
1480 Lenox Rd., Schenectady, N.Y.*
William H. Fulton, '00; January 18, 1974; 17
Birch St., Chelmsford, Mass.
Arthur P. Porter, '04; March 30, 1974; Little
Meadow, Sunderland, Mass.
Fred W. Goldthwait, '05; February 12, 1975;
Box #231, Center Sandwich, N.H.*
Warren K. Lewis, '05; March 9, 1975; 29
Peterson Rd., Duxbury, Mass.
Arthur J. Manson, '05; January 16, 1975;
P.O. Box 10117, Houston, Tex.
Howard P. Shaw, '06; February 9, 1975; 46
Boardman Ave., Melrose, Mass.
Brother M. Daniel, '09; April 23, 1974;
Maryknoll Seminary, Glen Ellyn, Ill.
Charles Freed, '09; February 11, 1975; 42
Clearwater Rd., Chestnut Hill, Mass.
Barry H. Jones, '09; December 25, 1974;
RD #1, Box 155, Rosendale, N.Y.
Clyde W. Osborne, '09; May 30, 1973; 2526
N.E. 27th Ave., Portland, Ore.
Walter R. Dray, '10; April 1, 1973; Box 178,
Yorkville, Ill.
Stafford A. Francis, '11; February 20, 1975;
c/o Newhill, 2404 E. Lake Huibrige Dr.,
Winter Haven, Fla.
Joseph N. French, '11; February 28, 1975;
28536 Elmira, Livonia, Mich.
O. Robert Schurig, '11; December 8, 1974;
Schoharie Tpk., Duaneburg, N.Y.
Paul R. Lawrence, '12; July 17, 1973; 316
Peebles St., Sewickley, Penn.
Eugene L. MacDonald, '13; February 1,
1975; RD #1, Pennington, N.J.*
Lester L. Downing, '14; July 25, 1974; 108
Crescent Rd., Concord, Mass.*
Stanley W. Merrill, '14; February 12, 1975;
43 Bracebridge Rd., Newton Center, Me.*
Irving T. Thornton, '14; November 6, 1974;
99 Bank St., Apt. 5-1, New York, N.Y.*
Lester E. Armstrong, '15; June 13, 1974;
4815 7th Ave. West, Brandenton, Fla.
Harry J. Murphy, '15; January 22, 1975; 15
Fayette St., North Quincy, Mass.*
Edmund M. Hayden, '16; February 21,
1975; 77 Simms Rd., Kensington, Conn.*
Maurice E. Strieby, '16; January 11, 1975;
175 Sagamore Rd., Millburn, N.J.*
Roger B. Brown, '17; January 28, 1975; 24
High St., Marlboro, Mass.
G. Dana Spear, '17; February 3, 1975;
29341 Thornhill Dr., Sun City, Calif.
Frederick M. Estes, '18; August 24, 1974;
641 River Dr., Port Ritchey, Fla.*
Alfred P. Grossman, '18; September 16,
1974; 160 Sewall Ave., Brookline, Mass.
Howard M. Simonds, '18; January 7, 1975;
c/o Stevens, 54 A Charles St., New York,
N.Y.
Harold C. Moberg, '19; February 5, 1975; 12
Idlewood Dr., South Yarmouth, Mass.
Carl G. Polson, '19; November 27, 1974;
RFD #1, 110 Salt Rock Rd., Barnstable,
Mass.*
Edgar R. Smith, '19; September 18, 1974;
P.O. Box 52, Lottsburg, Va.
Henry E. Wilson, '19; January, 1975; RR
#2, Kezar Falls, Me.*

- John W. Crowley, Jr., '20; July 25, 1974;
200 Gaylord St., Denver, Colo.*
George R. Knight, '20; February 20, 1974;
161 Moraine St., Brockton, Mass.*
Arthur H. Radach, '29; February 20, 1975;
14 Capt. Small Rd., South Yarmouth,
Mass.*
Mott B. Ross, '20; August 9, 1974; 184 West
Oak St., Basking Ridge, N.J.
Samuel Ruttenberg, '20; February 18, 1973;
16 West 77th St., New York, N.Y.*
Robert M. Felsenthal, '21; February 21,
1975; 7 Woodcock Ln., Westport, Conn.*
Ralph E. Ferdinand, '21; December 23,
1974; P.O. Box 1013, Marshfield, Mass.*
Frederick E. Haeberle, '21; Apt 1-F, 1155
Star Park E., Coronado, Calif.
James LeGrand, '21; October 6, 1974; 625
S. Alton Way, 10B, Denver, Colo.*
Wallace C. Norling, '21; August 19, 1974;
19 Auburn St., Brockton, Mass.*
Lucian G. Schlimgen, '21; July 30, 1973;
4701 Sheboygan Ave. #315, Madison,
Wisc.*
Wilford Seitz, '21; November 28, 1974; 305
42nd St., Sandusky, Ohio*
Arthur A. Turner, '21; January 8, 1975; 686
S.W. 4th St., Boca Raton, Fla.*
E. G. Widell, '21; August 13, 1974; 200
Harding Pl., Nashville, Tenn.*
Paul H. Choquette, '22; December 1974;
RR #1, Box 268; Saunderstown, R.I.*
Richard E. Donnelly, '22; January 1, 1974;
41 River View Dr., Chatham, Mass.*
Charles D. Mackintosh, '22; January 7,
1975; Box 15035, St. Petersburg, Fla.*
Roger S. Walke, '22; December 24, 1974;
2263 East Calle Alta Vista, Tucson, Ariz.*
Ellsworth M. Wilson, '22; December 3,
1974; 36 Elm St., Westerly, R.I.*
Ernest L. Akerley, '23; February 19, 1972;
6307 Berwick, N. Madison, Ohio*
Lewis T. Batt, '23; January 1, 1974;
Pittsford, Vt.*
Clarence A. Braukman, '23; October 30,
1974; 10433 W. Arkansas Dr., Lakewood,
Colo.*
Carroll Deitrick, '23; July, 1973; 13 Maple
Ln., Watsontown, Penn.*
Charles H. Lusk, '23; November 4, 1974;
5222 S. Harper Ave. Apt. 510, Chicago,
Ill.*
Lloyd J. Porter, '24; December 22, 1974;
630 S.W. 6th St., Villa 21, Pompano
Beach, Fla.
Peter Anastos, '25; January 11, 1971; 15
Perkins Sq., Jamaica Plain, Mass.*
Spencer A. Townsend, '25; August 13,
1974; 1656 Rockwood St., Los Angeles,
Calif.*
Arthur R. Baird, '26; April 25, 1974; 535 S.
Curson Ave. W., Los Angeles, Calif.*
A. Sidney Brookes, '26; December 16,
1974; 108 Chatham St., Chatham, N.J.
John G. Fletcher, '26; January 21, 1975;
210 Pier A, Naples Yacht Harbor, Naples,
Fla.*
Frank E. Strickland, '26; July 26, 1974; 6808
34th Ave. N.W., Seattle, Wash.*
Frank M. Toperzer, '26; January 1, 1975; 45
Winford Way, Winchester, Mass.*
Leland D. Whitgrove, '27; September 4,

1974; P.O. Box 366, San Luis Rey, Calif.*
Kenneth L. Conger, '28; March 22, 1974;
211 Prospect St., Wakefield, Mass.*
Charles W. Ricker, Jr., '28; July 4, 1974;
2721 Harrison St., Evanston, Ill.*
Herman A. Ellis, '29; July 3, 1974; 120
Steamboat Ln., P.O. Box 335, Ballwin,
Mo.
Arthur M. Robinson, '29; January 20, 1975;
67 Montview St., West Roxbury, Mass.
Chester W. Smith, '29; August 22, 1974; 2
Rogers Ave., Lynn, Mass.
Jack R. Bloom, '30; December 16, 1973;
P.O. Box 641, Bonita Springs, Fla.*
John M. Gaines, '31; October, 1974; Box
622, Millerton Rd., Lakeville, Conn.
Harry C. Jepson, '31; October 8, 1970; 202
South Washington St., North Attleboro,
Mass.
Leo P. Leino, '32; January 14, 1975; 25
Gate House Rd., Westminster, Mass.*
Robert O. Minter, '32; August 26, 1974;
3242 S.W. 58th Ave., Miami, Fla.
Arthur Y. Moy, '32; July, 1968; Box 3856,
Aspen, Colo.*
J. Cecil Rowe, '32; February 2, 1975; 910
Keystone Dr., Cleveland Heights, Ohio
Samuel T. Strueland, '32; May 7, 1974; RFD
Box 161B, La Crosse, Wisc.*
Walter E. Zimmerman, '32; November 13,
1973; 1224 Austria Ave., Miami, Fla.
Charles C. Bell, '33; March 9, 1975; 180
Wamponoag Rd., E. Greenwich, R.I.*
Wallace W. Fullerton, '33; December 22,
1970; 306 Windsor Ave., Wayne, Penn.
August J. Kreuzkamp, Jr., '33; June 5,
1970; 44 Bingham Cir., Manhasset, N.Y.
Kirtland Manley, '33; January 14, 1975; 410
Charlton Ave., South Orange, N.J.*
Richard S. Rowe, '33; December 15, 1973;
72-790 Homestead Rd., Palm Desert,
Calif.
Edgar W. Schulenberg, '33; February 7,
1975; 277 Central Ave., Fredonia, N.Y.
W. Franklin Baxter, '34; January 31, 1975; 4
Richard Ave., Shrewsbury, Mass.
Edmond A. Chandler, '34; February 14,
1975; Box 84, Deerfield, N.H.*
Herbert W. McKeague, '34; September 25,
1974; 5700 N.W. 2nd Ave., #402, Boca
Raton, Fla.
Robert C. Moore, '34; November 7, 1974;
1560 Bauman Dr., Ambler, Penn.
Russell H. Venn, '34; January 4, 1975; 5913
Crab Orchard, Houston, Tex.
Paul W. Daley, '35; February 22, 1975;
1813 S. Shore Dr., Holland, Mich.
John M. Teasdale, '35; December 25, 1973;
89 Boardman Rd., Poughkeepsie, N.Y.*
Alden H. Anderson, '36; January 25, 1975;
24 Baker St., Lynn, Mass.*
Arthur M. Cohen, '36; March 22, 1974; 19
Stony Point Rd., Westport, Conn.
James H. Leary, '36; May 10, 1974; 17 Put-
nam Pk., Greenwich, Conn.
Goodwin DeRaismes, '37; January 24,
1975; 1515 Washington Ave., Wilmette,
Ill.
J. Robert Fischel, '37; February 26, 1975;
145 Atlantis Blvd., Atlantis, Fla.
Edouard R. Bossange, Jr., '38; December
23, 1973; 5920 Park Ln., Dallas, Tex.*

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RADFORD Donald H RAYMOND John W Jr
REEVES Bartow V RICHARDSON William E
ROBINSON George A ROBINSON Harold A
ROSENBERG Julius C OWLEY Charles B

Lloyd M. Hier, '38; May 31, 1974; Furnace Rd., Pittsford, Vt.*

Virginia Pierce, '38; February 4, 1975; 6249 Ferry Dr. N.E., Atlanta, Ga.*

S. Charles Tsiang, '38; September 28, 1974; 58 10th St., Roxboro, P.Q., Canada*

Harold W. Gaunce, '39; December 18, 1974; 3707 St. Andrews Dr. S.E., Albuquerque, N.M.

William J. Hawley, '39; December 11, 1974; 541 Middle Rd., Farmington, Conn.

R. Wayne Parcel, '39; September 17, 1973; P.O. Box 2366, Harlingen, Tex.

Alan W. Baum, '41; January 19, 1975; 2425 Sage Rd., Apt. 48, Houston, Tex.

Michael G. Rogers, '42; March 9, 1973; c/o Olga Andrews, RFD #1, Farmington, Me.

Edwin R. Lord, '43; September 7, 1974; 2 Sandra Cir., Warwick, R.I.*

Albert P. Brogle, '44; January 23, 1975; 19 Robin Rd., Rumson, N.J.

Edward W. Habicht, '44; February 7, 1973; 105 Cottonwood Dr., Williamsville, N.Y.

Gilbert J. Ahrens, '46; August 15, 1972; 2601 Applewood Dr., Titusville, Fla.*

George A. Philbrick, '46; December 1, 1974; Reyfield Point, Cotuit, Maine

Hugo Mach, '47; December 14, 1974; 20822 39th Ave. S.E., Bothwell, Wash.

Rees E. Tulloss, '47; August 2, 1972; 433 Concord Rd., Weston, Mass.

John D. Harms, '48; December 26, 1974; 1324 Alfred St., Charlotte, N.C.

David E. Higginbotham, '48; January 13, 1974; U.S. Coast Guard Academy, New London, Conn.

Harold F. MacWilliams, Jr., '48; January 25, 1975; Box 2594, Staunton, Va.

Hugh M. Richardson, Jr., '48; April 12, 1972; 5801 Wilshire Dr., Nashville, Tenn.

Fred V. Annis, '50; February 4, 1975; c/o Mrs. Royal Sickles, 280 Annis Ct., Chillicothe, Ohio

Hans Kaarstein, '50; January 22, 1975; Borgenbraten 39, Asker, Norway

Ralph A. Vitti, '52; December 14, 1974; 826 Watertown St., West Newton, Mass.

William Hansen, '56; January 24, 1975; 7530 Oak Glen Ct., Falls Church, Va.*

William M. McMunn, '56; May 20, 1974; 877 Fairfield Rd., Pittsburgh, Penn.

Roger L. Cameron, '57; March 2, 1974; P.O. Box 388, Jackson, N.H.

Henry M. Cutler, '57; May 8, 1974; 5353 Expressway, Jacksonville, Fla.*

Edward R. Taylor, '57; April 11, 1972; P.O. Box 307, Borrego Springs, Calif.

Clarence J. Krueger, '59; January 17, 1975; 2235 Pleasantvue Cir., Pittsburgh, Penn.

William T. Rice, '62; November 11, 1974; Bayberry Ln., Belle Mead, N.J.

F. Ross Madole, '64; January 8, 1966; 3644 McFarlin, Dallas, Tex.

William O. Brown, '64; December 25, 1974; 4005 Olivev Ave., Sacramento, Calif.

Edward R. Eaton, '67; July 6, 1974; 47 Sherburn Cir., Weston, Mass.

William B. Watts, '68; November 19, 1970; 6205 Newberry Rd., #1407, Indianapolis, Ind.

* Further information in Class Review

The 1975 Centennial Edition of the MIT ALUMNI REGISTER will contain:

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- Geographical listings
- Business address & title
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Class Review

96

William D. Coolidge, who died on February 3, was the most noted member of the class and in the class book published before the 50th Reunion a full page picture of him was affectionately titled "Our Own Dr. Will." I first met him when I had a G. E. grant given to high school physics teachers. Several of the well-known scientists at the laboratory, one of whom was Dr. Coolidge, were good enough to give of their time to talk with us. When I inherited this secretarial job, I received a most cordial letter from him which resulted in several well-remembered visits to Schenectady. Even after 60 years he still had a keen interest in what was happening in elementary teaching! In the Institute Review section of this month there is more information about his life. The class extends its sympathy to his family.

Just before **Richard O. Elliot** reached his 102nd birthday, he decided it was time to retire. He had served for many years on the advisory board of the Maine National Bank. To honor the occasion, the president and senior vice president journeyed to Thomasston from Portland and joined the manager of the local branch in presenting a plaque to Mr. Elliot. — **Clare Driscoll**, Acting Secretary, St. Joseph H. S., Box 517, Frederiksted, St. Croix, U. S. Virgin Is. 00840

99

Word has been received from **Walter W. Wells'** sister, Mrs. Jean W. Main of Princeton Junction, N. J., that Walter died on December 15 just one month after his 101st birthday. He developed pneumonia, having been quite well up to that time. — **Norman E. Seavey**, Acting Secretary, 20 West Lucerne Circle, Orlando, Fla. 32801

00

"I believe some news from the class of '00 should be included this year — the 75th anniversary of our graduation" writes **Charles E. Smith**. He wrote to the other members of his class in September, 1974: "I have not been Class Agent for several years. This is not a solicitation for funds, but if you have any surplus, Tech can use it. Not having read any news of our class in the *Technology Review* for several years, it occurred to me that a gentle urge might bring forth how we are doing. I'll start it."

"After retiring in 1949 as vice president of the N.Y.N.H. and H.R.R. — now merged with the much-troubled Penn Central R. R. — I went to the Hawaiian Islands as a delegate of A.S.C.E. to visit the Local Section, Mexico, to a fiesta of M.I.T. Alumni, Brazil as Railway Consultant of the World Bank, and Spain at the instance of our Government Aid.

"I have accompanied Mrs. Smith on auto trips throughout the U.S. and Canada to witness fall foliage and to attend conventions of the National Council of State Garden Clubs. Arthritis has put me in a wheel chair, but otherwise I am in reasonably good health starting my 98th year. I believe I am a year older than you young fellows, as I dropped out after the third year, and worked 15 months to get enough money to make the fourth year, one year late. I hope you are all happy."

The daughter of **Walter L. Rapp** wrote in answer to Mr. Smith's letter that her father died in March, 1973, four days before his 96th birthday. "He had a most distinguished career as an architect here in Cincinnati."

From **Nathaniel D. Rand** he received: "What a happy surprise to receive your Sept. 5 letter. I'm in my 96th year and in fairly good health. I am living with my son Robert and daughter-in-law Molly, who are doing everything to make me comfortable. Bless them. (Bless all Mollies who take care of their old folks.)" The following month he received the following from Nat's son: "I am sorry to have to tell you that my dad passed away on October 18. He enjoyed the communication with you and your letter."

The letter to **Fred L. Townley** was returned marked "undeliverable." A letter to the "occupant" brought the following: "I am sorry to report that your former classmate Fred Townley died at least a year ago."

A letter received from **Mrs. E. Avery Forbes Jr.** (Katherine), daughter of **Stanley Fitch** advising that with the aid of Mr. Vincent Fulmer, '53, of M.I.T. he was able to attend the Alumni Day celebration at M.I.T. in June, 1974, where he was featured and had his picture taken as the oldest alumnus in attendance. He had a distinguished career as a public accountant in New York and Boston. In recent years he has faithfully attended the dinner meetings of the Alumni Council.

Arthur White wrote to Mr. Smith from Riverside: "I was married in 1904 and came to California at once and have been here ever since; some of the time in engineering but most in land development and ranching. I have tried alfalfa, peach and citrus raising.

Most luck in land. I have been busy looking after my own properties. I have six children — five sons and one daughter, 14 grandchildren and 13 great grandchildren. Two are graduates of Annapolis; one from West Point. They were all in active service during the big war and all came through without accident."

"Looking back 75 years rouses many memories," writes Mr. Smith. "At Boston Tech on Boylston St. we had the privilege of intimate association with excellent teachers — among them Swain, Allen, Porter and Burton in Course I. Our engineering building looked down on the site where John Hancock recently suffered. We Civils had the rare opportunity and privilege of visiting and observing the Arlington Street Park Place Subway during construction."

"What has M.I.T. done for me? Soon after graduation I was reminded over and over again that a graduate of M.I.T. was a very special person. The acceptance by others became warmer and more respectful. It is certain that important assignments resulted. The New Haven R.R. entrusted me with the design of many bridges which now — over 70 years later — are carrying much heavier and faster trains with unquestioned safety. When that work was completed there followed: steel designer, Corps of Engineers, U.S. Navy; textbook writer, International Correspondence Schools; special investigation of earthquake and fire damage at San Francisco for the U.S. Geological Survey; full charge of design, construction, maintenance and safety of all bridges on 7200 miles of the Missouri Pacific Railroad from Illinois to Colorado, and from Omaha to the Gulf of Mexico. From 1915 to 1927 I was on my own as consulting engineer in St. Louis. (Believe it or not, my problem there was 'should the 5 cent subway fare be increased to 6 cents?' That was in 1927.) During these years I took time out to serve as Major, Construction Division, U.S. Army, during World War I."

"A very tempting offer to return to New England as vice president to assist the president of the New Haven R.R. brought me back east January 1, 1928, where my service took me through the distressing bankruptcy brought on by the depression of the 1930's followed by the offsetting heady profits of World War II, during which the railroads performed miraculously."

"In this period I doubled — part time — as a Dollar a Year man in Washington followed by service as a member of a Task Force of the First Hoover Commission for the Reorganization of the Federal Government.

These were two of ten occasions when various departments of our government called me into service.

"What have I done for M.I.T.? Too little, I'm sure, included were: Class Agent for many years; President of the Alumni Association; term member of the Corporation; Chairman of the Visiting Committee of Civil and Sanitary Engineering." — M.L.

03

This seems an opportune time to call the attention of our remaining classmates to the last funds of many departed members, providing scholarships for our classmates' children or grandchildren.

This welcome provision still awaits our early request and provides for the approaching semester.

Our Happy Birthday notice now proclaims **George St. Garcelon VI**, born March 26, 1882. His address is: 55 Cooper St., Agawam, Mass. — **John J. A. Nolan**, Secretary, 13 Linden Ave., Somerville, Mass.

05

It is with deep personal grief that I report "Goldie's" death. **Fred W. Goldthwait**, age 92, our beloved class secretary for over 40 years, and always a faithful supporter and worker for our class, died February 11, 1975 in Laconia, N.H.

Fred was born in Peabody, Mass., July 8, 1882, attended school there and graduated from M.I.T. 1902 (Course II).

During 1904 and 1905 Fred served as summer councillor at Camp Wildmere for boys at East Parsonsfield, Me. He spent a short time as inspector of parts with the United Shoe Machinery in Beverly. After that he went to Philadelphia with the Lanson Monotype Machine Co. and became instructor of monotype, operating in several printing plants around Boston and establishing monotype typesetting machines in place of linotype machines. During this occupation, he contracted lead poisoning which ended his career in this business. After about a year he was cured but found it necessary to avoid indoor work and went into selling.

Fred became president in 1908 of the Duro Pump Co. in Boston and served in that capacity and as sales and hydraulic engineer for 50 years. During this time the Goldthwaits made their home in Melrose. Fred was a 50-year member of the National Grange and the Masons, belonging to the Blue Lodge in Peabody, the Royal Arch Chapter in Melrose and Aleppo Temple in Boston. He was also a member of Holton Lodge of Odd Fellows in Peabody.

Since Fred's retirement in 1958, he and Ruth have made their home in Center Sandwich, N.H. — calling their adorable home "Hobby Knob." Many classmates, including Peggy and me, have enjoyed the wonderful hospitality of the Goldthwaits. The Goldthwaits endeared themselves to the folks of Center Sandwich where Fred held various volunteer community jobs. Mr. John N. Dyer, '31, writes, "The loss of Fred is very deeply felt up here in this village of 800 people. At a meeting of the local civic club, the Sandwich Town Club, the enclosed resolution was passed: 'Be it re-

solved that the members of the Sandwich Town Club express their deep sorrow at the passing of Fred Goldthwait, a charter and an honorary member of the club. Fred has been a most faithful, dedicated member, who was devoted to the community of Sandwich and who contributed greatly to its welfare. Full of fun and the enjoyment of his family and his fellow man, he will be remembered by all who knew him as one of the best of men. Passed unanimously by the Members of the Sandwich Town Club at their meeting of February 14, 1975."

Mr. Dyer also says "when I last saw Fred, a few days before his last hospitalization, he was working hard with Ruth on his class reports and in spite of his condition was happy and bright."

Fred is survived by his widow Ruth (Leveridge), five daughters, Mrs. Marjorie Richardson of Boston, Mrs. Hugh (Nancy Ray) Craigie of Mountainside, N.J., Mrs. Norman (Lucy) Anderson of Bethlehem, Penn., Mrs. Hazen (Carol) Bickford of North Reading, Mass., and Mrs. Daniel (Ruth) Maynard of Newark, Del., and 13 grandchildren.



Here's "Goldie" as we '05ers will always remember him! What a beautiful heritage he has left us.

We will all miss Goldie; losing him for me is like losing a brother, we were so close. In all the years, Fred has missed only one Alumni Day and I cannot recall one reunion that he missed. Until we moved to Florida in 1969, my attendance at the M.I.T. meetings in Boston and Cambridge was pretty good, but not equal to Henry Buff's and our faithful secretary's.

I am going to try to carry on with class notes in T.R. — depending on help from my fellow classmates. — **William G. Ball**, Acting Secretary, 6311 Fordham Pl., Bayshore Gardens, Bradenton, Fla. 33505

06

Mark A. Wounola, '69, has written about **Samuel L. Ware**, presently the oldest living member of the Delta Chapter of Theta Xi. From his article: "Sam held several chapter offices, and was president of the Naval Architecture Society while a student at M.I.T., before he graduated in 1906. He joined, in 1908, a well-known Boston firm of architects and engineers, Shepley, Rutan and Coolidge. By the time the First World War broke out, he was married and living in South Weymouth. In April, 1917, he enlisted in the Navy as Captain in the Naval Reserve. . . . In the spring of 1918 he accepted

the position of assistant chief supervisor for the U.S. Shipping Board at the Quincy yard. . . . He supervised the building of U.S. cargo vessels in China and Japan from 1919 — 1922.

"When Sam returned to the States, he accepted a position with Lockwood, Green and Co., Inc., until 1928, when he became a partner of Cleverdon, Varney and Pike of Boston. These were to be interesting years; for that same year the firm embarked on the restoration of Williamsburg, Va., a project underwritten by John D. Rockefeller, Jr. Before the work was begun, Sam presented his plans for Christopher Wren Hall, the oldest building of this country's second oldest university, the College of William and Mary, to an engineer, Rockefeller's agent, who then gave the go-ahead for the project.

"When his firm closed in 1942 because of World War II, Sam retired. He has pursued his main avocation, sailing, on his yacht named "Knave". He has been a member of the Scituate Harbor Yacht Club since its incorporation in 1940, and served as its commodore in 1947. He was for many years trustee and deacon of the North Abington Congregational Church. Since 1947 he has been trustee and co-chairman of the building committee for the South Shore Hospital in South Weymouth." — M.L.

07

M. Herbert Eisenhart, former president and chairman of Bausch and Lomb, Inc., the optical goods manufacturer in Rochester, died there on January 7, 1975. He was 90 years old. From the *New York Times*: "Mr. Eisenhart, who joined the company in 1917, became president in 1935 and chairman in 1949. He retired in 1955. He held strong views on the importance of optical goods in warfare and after World War II warned that the United States must never lose the supremacy in the field it had won from Germany during the war. Mr. Eisenhart earned a B.S. degree from Princeton University in 1905 and a B.S. in chemical engineering at M.I.T. in 1907. He leaves two sons, Richard H. and Edward C. Eisenhart; a daughter, Eleanor Morris; seven grandchildren and 11 great grandchildren. — M.L.

11

Willis K. Hodgman Jr. writes: "Continue to hold the title of Board Chairman. Duties are rather informal. Am mostly retired. Still in quite good health and fairly active."

John A. Herlihy, 86, died January 7, 1975 in Medford, Mass. From the *Boston Globe*: "Mr. Herlihy joined the Edison service and supply department in 1913 and rose steadily to become a vice president. He retired in 1953. During World War I he served with the air wing of the Army in France and was discharged with the rank of Captain. He was a member of the M.I.T. Alumni Association, a life member of the Medford Council Knights of Columbus, a member of the Irish Charitable Assn. and he was a trustee and director of the Lawrence Memorial Hospital. He leaves two sons, John I. of Chicago and Richard C. Herlihy of Melrose; a daughter, Mrs. Marie E. Ledden of Delaware and 12 grandchildren. — M.L.

12

Last year your secretary alone attended all of the alumni reunion events which are held the first weekend in June. **Fred Busby** and I were the only 1912 men at the class luncheon. Can't we do much better this year? Please write me if you plan to come.

Jonathan Noyes writes that he is in good health and plans to spend the summer at the cottage in Brooklin, Maine where he has vacationed since his youth and has many friends. He entertained my Helen and me there in 1972. Jonathan spends most of his time in Texas visiting among his many married children, most of whom live relatively nearby. . . . **Chester Dows**, noting the recent lack of 1912 news, wrote last March from Cleveland. He recently had cataract operations for both eyes and the first has recovered sufficiently for him to see. Then after recovering from a prostate he was recently laid flat with a severe case of arthritis. His daughter has come from N.Y. to live with them as his wife, Frances, requires care due to polio which she has had for many years. Chet has had much more than his share of trouble this year but his spirits seem to be good. My very best wishes for better health which I know is shared by all our classmates. . . . **John Barry** wrote from his new home in Cohasset that he and his wife are in good health but he has recently lost six of his good friends and neighbors. He enclosed the following news clipping with its very sad notice.

Cyrus F. Springall, 86, died suddenly in Andover, Mass., on January 29, 1975. Cy was one of our most loyal alumni and always attended our annual alumni reunion luncheons, even when it was necessary to use a wheelchair. After service in World War I as a Navy aviator, he opened his own business office as an architect in Malden, Mass., and designed many structures, public and private, including the Logan Airport, in Boston and vicinity. He was active in several community and church activities, including the Rotary Club, Masons, Odd Fellows, Republican clubs, as well as a director of three local banks and the American Association of Architects. He is survived by his wife, Marjorie, his son Thomas, two grandsons, of whom he was most proud, and a sister, to all of whom we send our sympathy. All of us shall miss him. — **Ray E. Wilson**, Secretary, 304 Park Ave., Swarthmore, Penn. 19081

13

When you read these notes, it will be spring and time to gather the May flowers and the hepaticas. It was with pleasure that we read in the February Issue of the *Technology Review* that Don Severance has been appointed director of the Volunteer Leadership Appeal (see page 79). We have known and enjoyed Don's friendship since he graduated and became Assistant to the Registrar with "Doc" MacKinnon.

We have enjoyed receiving and reading several letters and copies of his lectures from **Edward M. Bridge**, in which he referred to his extensive travels in Europe and other countries: "It has been a long time since I have written to you. I enjoy your reports to the M.I.T. Class of 1913. I shall be 86 years old on June 26, 1975. I hope you

are in good health; I'm in excellent health and continue to drive my car about town. Years ago, I took a course in public speaking. My son, Richard, also an M.I.T. architect, lives nearby."

We received a letter from Mrs. A. D. Strock, sister-in-law of **C. Preble Wetherbee**: "Thank you for the sympathy card from the 1913 Class of M.I.T. Mrs. Wetherbee was my sister and when their health failed, they came to live with me. Irene passed on in Jan., 1973, and Preble remained with me as he needed some nursing care. He did not speak of his accomplishments but I know he went to Bell Telephone of Penn., in the Engineering Dept., upon graduation from M.I.T., and always was in the Philadelphia Office. When he retired, he was traffic supervisor of Eastern Division. He played golf and enjoyed bridge. He had no hobbies, but was an avid reader and listened to good music."

An interesting note has been received from Arthur Hirst: "Sorry, but I am most of a wreck at 85, so much so that I can't travel, and cannot attend the reunion. My best to the gang."

Mrs. John F. Doyle, 435 East 70th St., New York, N.Y. 10021 writes: "This is to inform you of a change of address for my father, **Gilbert R. Pardey**. He is residing in a nursing home — he has been blind for the past two years. The new address: Gilbert R. Pardey, 800 River Road, New Milford, N.J. 07646." We are very concerned about Gil Pardey and we hope that he may recover his sight.

We were quite sad to learn from the Alumni Association that **Eugene L. MacDonald** passed away February 1, 1975. Gene was one of our well-known classmates and a National Civil Engineer who received many citations from engineering societies. We have sent a card of sympathy to his dear wife, Mary.

We must report several changes of address of our classmates: Frederick Kennedy, 2705 Mt. View Drive, LaVerne, Calif. 91715; Kenneth A. Scott, Route 2 — Box 50, Ethelville, Ala. 35461; Allison Butts, Lehigh Manor, Hanover Ave. and Waheta St., Allentown, Penn. 18103.

Until next month, good luck. — **George Philip Capen**, Secretary and Treasurer; **Rosalind R. Capen**, Assistant Secretary, Granite Point Road, Biddeford, Me. 04005

14

In the space provided for a message on the envelope in which he sent his check to the Alumni Fund, one of our good classmates wrote, "Can't you scare up more news about the rest of the class?" My excuse is that I'm no good at fiction; but if just a fair number of classmates who haven't told me anything for a year or more (or ever) would consider themselves scared enough to write me now, I could do rather better than I've been doing lately.

Jim Reber wrote in December that he thinks an interim reunion in 1976 is a good idea, and that he's looking forward to being there. . . . **Roy Parsell** told me in January that he's still a practicing patent attorney and a member of the Madison (Conn.) Conservation Commission, trying to keep some open space with trees and wild life.

Alden Waitt wrote in January that a ground-breaking ceremony was about to

be held for the art school building for which he's raised most of the funds. Alden's success in this good work makes me feel that he should be our class agent, even though that might well be expensive for the rest of us.

The Alumni Records Office was informed in February that **Lester L. Downing** had died on July 25, 1974. The class records show that he was with us in our third and fourth years, graduated in Course II, and in 1919 was assistant marine superintendent of Crowell and Thurlow, of Boston. In 1917 he married the former Elinor Haines. He always lived in the Boston area — for the past 18 years in Concord.

Irving T. Thornton died on November 6, 1974. He was in Course X with us in our fourth year and went with Lackawanna Steel Co., in Buffalo, in 1914. In 1918 he was in the service as a lieutenant. Since 1918 he had lived in lower Manhattan.

Stanley W. Merrill died on February 12, 1975. He was with us only in our freshman year. All that our records tell about him is that he lived all his life in Newton Center, and in 1920 was employed by the Stetson Shoe Co. Can anyone give me information for adequate notes on any of these classmates? — **Charles H. Chatfield**, Secretary, 177 Steele Rd., West Hartford, Conn. 06119

15

Another sad loss for our class — **Harry Murphy** died January 22 in Hingham, Mass. Harry was founder and president of the Massachusetts Engineering Co. of Avon, Mass., manufacturers of large steel tanks. He was in the Army Air Corps in World War I. He was active and generous in all class and alumni activities. His wife Lucy and the feminine side of his family were the life of the party with their gay hats, at our annual June cocktail party. Representatives of the class attended Harry's wake and service. Our 60th Reunion will be a cocktail party at the M.I.T. Faculty Club, 50 Memorial Drive, at 4 P.M., followed by dinner there at 6:30 P.M. on Friday, June 6. All this for free to our classmates and their families. You already have received the notices.

Phil Alger starts us off for this celebration with his original poem:

"The 60th Reunion of 1915
We are but few, as old age nears,
Now that our age is sixty years,
Crowned with honors that gray hair earns,
Our '15 class to Tech returns.
Boston Tech in our gay teen years
Was filled with hope, and free of fears.
Bicycles were in style, and skates,
And walking was the thing for dates.
In two world wars we served with skill,
By words and deeds we climbed the hill
To earn success and gain rewards
Of friends' and teachers' high regards.
Now, at last, we give way to youth —
In progress and the search for truth,
May Tech men ever take the lead —
Ably to serve our country's need."

These "snow birds" are luxuriating in the warm climes: **Wayne Bradley**, Hollywood Beach; **Dinger Doane**, Southport, N.C.; **Mona** and **Clive Lacy**, Orlando; **Larry Quirk**, Los Angeles; **Jim Tobey** (suffering in the heat), Lake North; **Gil Peakes** spent Christmas with his daughter at Monogahela, Penn. . . . We're all glad that **Jerry Coldwell** has recovered from some serious eye

surgery. . . . Our Mary Rice continues her world traveling — just read a colorful letter from her February visit to Sao Paulo, Brazil: "My months stay with my son Pat and his family is nearly at an end here in Sao Paulo. I haven't learned much Portuguese, but it is enough like French, Italian and Spanish and I can guess at all I need."

Ray Stringfield is recovering from some additional surgery but feels well enough to circulate around with his friends in the many civic, social and business groups to which he belongs. Keep up your good work and good health Ray. So, here endeth the lesson with the hope I'm going to see many of you here on June 6 for our big 60th. — **Azel W. Mack**, Secretary, 100 Memorial Dr., Cambridge, Mass. 02142

16

Reminder: Our 59th Reunion at Chatham Bars Inn will be held on June 3-5 sandwiched between Commencement Day on June 2 and Alumni Day June 6 at the Institute. Again, we are expecting a good attendance and with luck some of those "on the fence" will come at least for part of a day. In addition to the usual business and the good time that we always have at our reunions, we will use this occasion to begin our planning for our 60th Reunion.

Let's start with this nice letter from **Jap Carr**: "After Christmas I had a two-week stay in hospital with a bad case of inflammation of the pancreas and while there developed gout in my right hand which has prevented tennis since then. However am hoping to get out on the courts in a few days. We are having a fine season in Florida, weather fine and we have a new heated swimming pool at the Bath and Tennis Club but our social activities are very quiet this season. . . . And this welcome letter from **Dan Comiskey**: "Sorry to learn of **Len Stone**'s passing and **Harold Dodge**'s continued illness. I have no special news but do enclose a clipping (1973) about the location of the original M.I.T. building on Summer Street, which clipping I had mentioned to **Len Stone** but never sent it to him. Perhaps you could use it somehow. **Frank Bucknam** and **Elbridge Devine** both have written that they are well and I am also." The clipping reads in part: "Located on the original site of the Mercantile Library Building in which Massachusetts Institute of Technology was founded, the Kennedy's building dates back to 1856. During the ceremony the Mercantile Library Building Commemorative plaque will be relocated to the prominent position on the Summer St. side of the store." . . . **Charlie Lawrence** certainly expresses the sentiments of his classmates when he writes to **Harold Dodge**: "1916 cannot be quite the same without your guiding influences as secretary but personal health must prevail in first priority. So my gratitude and commendations to you for the many hours and days over so many beautiful years for your capable services to your classmates and the Institute. Well done faithful friend."

He continues by sending an item about **Gordon Fair** who was Gordon McKay Professor of Sanitary Engineering at Harvard with a bright and lasting record of leadership and scholarly instruction to Harvard grad students. As mentioned in the article, Gordon attended M.I.T., was a member of

1916 and I collected dues from him many times — at that time he spelled his name Fehr. Gordon did receive A.B. and B.S. from M.I.T. and Harvard at the same time. As an undergraduate with us he was outstanding as a student and so very interesting as a person of varied experiences in the world."

. . . It is appropriate that we quote briefly from the article by William D. Monie in *The Journal of A.W.W.A.* of November 1974, entitled "Reminiscences about Gordon Maskew Fair (1894-1970)": "Fair began teaching at Harvard in 1918 as an instructor in sanitary engineering and continued to teach until his retirement, at the age of 70, in 1965. He became Gordon McKay Professor of Sanitary Engineering in 1935, Abbott and James Lawrence Professor of Engineering in 1938, was dean of the engineering faculty of the University from 1946 to 1949 and Master of Dunster from 1948 to 1960. A measure of the distinction that he achieved in his field is indicated by the fact that more than half of all the state directors of sanitary engineering had received advanced degrees from Harvard under Fair's direction. Among his other notable accomplishments was his leadership, during World War II, of a research group at Harvard that solved the difficult problem of the disinfection of water for American troops. During that war he also managed to organize programs in sanitary engineering for 21 republics in Latin America. This was a highly successful pioneering effort in international technical assistance."

Joel Connolly writes: "Recently we had a good letter from Mrs. **Robert E. Wilson**, who is recovering from a broken back and an operation." . . . Always nice to hear from **Dina Coleman**, who writes: "Life with me is very humdrum; however, last September on one of my semi-annual jaunts to Las Vegas to look at the girls, I made a side trip to Death Valley. To anyone who has an interest in geology or the origin of the earth itself, a two-day stay in Death Valley is a must. George Kettredge and I rode from one end to the other and it was a never-ending, unbelievable panorama. Not only that, the food and their own home-grown dates at the Furnace Creek Inn are good. Presently we are busy restoring the old Lexington Opera House where Jenny Lind and other great stars appeared. It is quite an undertaking. Hope to see you all in June." . . . **Frank Holmes** keeps us posted with this note: "Have spent five very enjoyable weeks here at Treasure Island, Florida. Weather has been the best in years. It is grand to get away from cold New England and relax. Still active in business but have relinquished most responsibilities to my nephew. Spend most of our summers at our cottage in Fitzwilliam, N.H. Best wishes to all." . . .

Unfortunately we must report the passing of three of our classmates since we last reported: **Maurice Strieby** of Millburn, N.J., on Jan. 11, 1975; **Edmund M. Hayden** of Kensington, Conn., on Feb. 21, 1975; and **Bob Burnap** of South Orange, N.J., on March 4, 1975. May they rest in peace. Of interest to our classmates will be this brief excerpt from the news item in the *New York Times* about Dr. Maurice Strieby's death: "Dr. Strieby contributed to the development of high-frequency wire transmission, coaxial cable systems for multi-channel telephone and television, radio transmission and communications engineering, and held

patents on more than a score of inventions. Later in his career he was a consultant in systems engineering for cable television. During World War II, Dr. Strieby served in a civilian capacity in organizing communications for the armed forces overseas, and received a Presidential certificate of merit. In World War I, he served overseas as a captain with the Army Signal Corps."

We had a nice letter from **Don Webster**'s son, Philip, that Don had surgery in late January and was then (Jan. 25) making a rapid recovery. . . . We also had good news in mid-March from a mutual friend that **Jap Carr** is now back on the tennis courts and playing three times a week . . . Keep your letters coming and as Cy Guething says, "Keep breathing." Hope we will see many of you on June 3-5. — **Ralph A. Fletcher**, Acting Secretary, West Chelmsford, Mass. 01863

17

It was good to have Doris and **Bill Hunter** in town so Bill could take in the February meeting of the Alumni Advisory Council. He was joined by **Al Lunn**, **Brick Dunham** and son Woody and yours truly.

Evidently **Bill Eddy** likes the Florida west coast too, judging from a note from Captiva Island. That is where a causeway sign warns, "Watch out for low-flying birds." There is a large wildlife refuge nearby.

From the several travelog pictures that **Stan Lane** has shown to us, we know that he and Helen have traveled worldwide. Now that they're making their first visit to Florida do you suppose that we may be favored with a Florida travelog?

A "half way" report by the Sailing Pavilion Committee shows that that is where the program stands which still leaves much to be accomplished.

"A former employee of one of the better known retailers is tapering off to a second retirement. As a Chicago storekeeper he found some years ago that his business trips to New York were as economically routed through Virginia as a direct route. So a farm in Virginia was purchased, planned, organized and operated on stop-overs and by absentee supervision until his first retirement. Six hundred acres of grazing land supported a large herd of cattle (two hundred? more? figures dememorize themselves for this one of his classmates). Corn, wheat, hay and oats are grown for a self-sustaining efficient unit operation. The farm established a home base and occupation for retirement interest. But now his son, in business for himself in nearby Virginia, has taken over farm supervision, following the same pattern of regular visitation with the resident manager.

Penn Brooks now tends only to a motley collection of directorships, trusteeships and other odds and ends, residues of his responsibility-crammed career. Clubs in his several city stopping points and gourmet dining with lucky friends help keep him from boredom in the high percentage of time away from the old Virginia home. Oh, a correction: those cities are not stopping points. His only known stopping anytime, anywhere, was during a brief attack of hepatitis, when even his martinis stopped. His mother lived to be 105 and understandably his own mental and physical level is proportionately younger than that of his classmates. His

third retirement from his collection of board memberships has not yet been scheduled." (The contributor of the foregoing shall remain unnamed.)

With regret, the death of **Roger B. Brown** on January 28 at Marlboro, Mass., is recorded.

These notes are enlivened when you write news on the Alumni Fund envelopes, and your secretaries appreciate the help.—**Stanley C. Dunning**, Secretary, 6 Jason St., Arlington, Mass. 02174; **Richard O. Loengard**, Assistant Secretary, 21 East 87th St., New York, N.Y. 10028

18

In two days spring will officially arrive and our thoughts will be uplifted by the resurgence of life — hopefully this will occur in our economy, and ecology. And we will have peace, as well as nature's rebirth. As indicated to you in the previous *Technology Review* issue — space did not permit the printing of all your seasons greetings to me. I therefore hasten to include those previously omitted — with apologies for delay but the messages are still timely.

Ned Longley has written from Santa Ana, California: "As is our custom we are spending the holidays with one of our daughters and her family of four fine children and an excellent husband in this pleasant community. We alternate our holidays with our other daughter who is equally blessed, in Salem, Ohio. All these young people, and we, are well and busy and happy. What more could we ask for ourselves and others other than peace and understanding in the world and a better condition for its mixed-up economy!"

"I believe I wrote you in 1973 telling you why we were not at the 55th reunion. A long-planned visit to England, Scotland and Norway with Helen and **Walter Robertson** was the reason. Walt and Helen wanted to explore the haunts of his father and earlier forebears and we never miss an opportunity to visit Hjordes's cousins in Norway and to roam that interesting and scenic land.

"As to paragraphs autobiographical, I am a bit reluctant to perform, for once has seemed enough. Back when Maggie was pounding the keys so voluminously and loyally for our class I did provide the principal facts relating to our happy marriage, our fine children and grandchildren, the move from New Jersey to Asheville, N.C., following retirement, my business connection and a pleasing amount of travel. Our move to Asheville has been rewarding. First of all, we escaped from the crowded area of northern New Jersey and found the fields and the woods and the mountains of western North Carolina. Departing from friends and associates and scenes of forty years was a bit difficult but we soon acquired more amongst the Tar Heels and we still have the old ones, though at a distance. — We are looking forward to the 60th and if all goes well we will be there."

Bill Wyer's greeting follows: "My travels are few, as I'm not allowed to drive any more, but we did get to California last spring for a sort of family reunion and to a few races at nearby Monmouth Park this summer. However, a slight stroke in June temporarily put an end to that, and I was out again just last week."

Jack Poteat despite sciatica is ever

cheerful: "Sciatica last winter and slow recovery through summer. Betty is standing up well as my nurse but she still has to help me put on shoes, socks and trousers! The high spot of the year was my 80th birthday in August when children and seven grandchildren came from the east to make it a real bash! Having thus been grounded in 1974 we hope for release in 1975 so we can do some visiting, if all the gasoline isn't gone. We've had a magnificent fall with no frost or snow at our 1,500-ft. elevation. The bright morning sun welcomes each day and blue sky and mild temperature make me completely satisfied that we left the hubub of the city for the joys of a small town. May 1975 treat you better than ever."

Faithful **Sherman MacGregor** does his stint modestly at V.A. Hospital: "I know it isn't etiquette to type a friendly letter, but if you could see my handwriting, you'd be glad I typed this note. My writing is getting worse every year and I don't know why. I suppose there is a psychological reason but what it is I don't know. But you can read this at least!

"You ask for news. Well, my friend, I don't have any. I lead a very quiet life here with my wife, and there is nothing to talk about. In fact, what I wrote years ago when you first asked me for news would be just about what I would write you today. I work two days a week at the V.A. Hospital here and realize every day how lucky I am to be in such good health. Because I am firmly convinced that good health is a lot of luck — heredity, environment, and all. You can take care of yourself as much as you like, but there's only so much that will work.

"I have just finished painting the trim on my house and if I do say so it was a good job. But I also have to admit that it wasn't as easy as it would have been a few years ago. And the view from the top of a twenty-ft. ladder isn't as attractive as it would have been a few years ago! But I managed to work it out without undue incident.

"I drove up north — 1500 miles each way — last summer, but I doubt that I'll ever drive it again.

Bob Rowe's card was most beautiful. His comments are succinct: "Answering your question, I have no panacea for the world of tomorrow. Nor has M.I.T. There is a continuing power ploy among physical scientists; social scientists; politicians; jurists; media; and revolutionaries (ideologists, anarchists, terrorists, racists, activists, etc). Perhaps this diversity bodes well for a free society. Me, I still alternate between my California and Michigan homes at six-month intervals — always busy on voluntary tasks, with neither deadlines nor honorariums. Incidentally, I am the only '18er contributing regularly to *Technology Review's* Puzzle Corner."

Tom Knowland's comment is as follows: "You are indeed my most faithful and loyal friend, and I will certainly (a personal promise) write up something before April — maybe sooner — though you know I feel my 'career' is quite par for the course."

"Re your query 'technology vis-à-vis society or problems' — of course it can affect such problems for good or evil — but cannot be a determinant, unless it can perhaps slow down the government printing presses. My feeling is that inflation is our biggest problem at the moment — and the presses are deeply involved. But the way, have you seen Samuelson's latest book? It's about

the best available.

"In heaven's name, Max, don't mention this note — I'll write you again soon!"

Jim Lee has our congratulations on his 80th: "Many thanks for the good wishes for 1975. A highlight for 1974 was the party on August 7 to celebrate my 80th birthday. I wish that some of the class of 1918 might have been here to help celebrate the occasion." . . . **stuart Elliott** — one of our many authors — pens his message: "A very Merry Christmas and a Happy New Year to Max Seltzer, and the M.I.T. class of 1918. Your card is beautiful and appropriate. As for M.I.T. solving societal problems, the first one and biggest is to solve the overswollen federal government. They are the root of many troubles." . . . **Sumner Wiley** reminds us in his card that there is snow in Maine: "Thank you for your very special greeting. We are to be here in the snow this Christmas with some of our family from Texas, Massachusetts and Maine. A very happy time. Our best wishes to you and Selma." . . . **Clarence Fuller** is the official historian of Foxboro — something he does not mention in his message: "We are both still remembering with pleasure the little party you arranged at the 'Red Snapper.' Our visiting time was too short but hope we can make up for it some time soon. Sorry, of course, to have missed out on the mini-reunion. Dot had her cataract operation October 2 and just now received glasses. She is trying hard to get used to them. No fun! I'm doing pretty good with the help of digitalis but can't do all the things I'd like to. Maybe the trouble is I'm getting too close to 100!"

I continue seasons greetings and pertinent comment from **Herb Larner**: "Ever so many thanks for your thoughtful card. Certainly I will try to send you something interesting for your column which I unfailingly enjoy reading. Actually I write quite a lot about one thing or another, but in the matter of class notes, I am a bit reticent, having in mind the story of the elderly fellow, who late in life, took a course in public speaking and was transformed from a timid gentlemen into a public nuisance."

I conclude with a note and holiday wishes from **Henry Pinkerton** together with a copy of a citation which is reprinted herewith. Congratulations: "Your letter was irresistible! For biography, see *Who's Who*. As for societal dilemma, I can only hope there is something better in the future than B. F. Skinnerism, and that M.I.T. will find it!" The enclosed citation reads: "The 71st annual meeting of the American Association of Pathologists and Bacteriologists, held recently in San Francisco, was the scene of the award of the Gold Headed Cane to Dr. Henry Pinkerton of St. Louis.

"The award, considered to be one of medicine's most distinguished, was presented to the 76-year-old pathologist for his research of the pathology of viral diseases such as influenza, yellow fever and encephalitis, and for rickettsial diseases such as psittacosis, typhus and rocky mountain spotted fever.

"The award is given periodically to a physician who represents the highest ideals in pathology and medicine. The cane is a replica of one at the College of Physicians in London that was used from 1689 to 1825 by British Royal Physicians."

I record herewith the death of **Frederick M. Estes** on August 24, 1974. — **Max Selt-**

zer, Secretary, 66 Longwood Ave., Brookline, Mass. 02146; Leonard Levine, Assistant Secretary, 519 Washington St., Brookline, Mass. 02146

19

A letter from Ed Moody, Hazel Pt., R.F.D. #3, Nashua, N.H. 03060, commenting on the 1975 Alumni Centennial and the Boston Bicentennial, says, "If any classmates who are coming are looking for a spot to stay a night or two, I have a guest room handy and food in the larder. I am just 35 miles from Cambridge. I shall be in Brockport, N.Y., in early May, Nova Scotia in August, England in September and early October, but at home for the 1975 Bicentennial."

Notice was received of the death of Carl G. Polson in Barnstable, Mass., on November 27, 1974.

Edward E. Scofield writes, "Although supposedly retired, I still seem to be busy most of the time since I have retained the name of my former business; however it has rather degenerated from being a heavy machinery operation to one largely concerned with accounting. Then too there are all the household repairs such as oil burners, washing machines, refrigerators, etc., the repairs of which partially compensate for inflation."

By letter from his son and newsclipping from the *Press-Herald*, Portland, Me., we learned of the passing of Henry E. Wilson, U.S.N. retired, at Kezar Falls, Me. on January 6, 1975. He was buried in a family burial in Old South Cemetery, Ipswich, Mass. He was born in Ipswich and attended Ipswich schools. He served in the Navy in World Wars I and II and retired after 30 years of service, to a tree farm in N. Parsonsfield, Me.

Your secretary has touched base with Nelson Bond, John Stevens, and Don Way who are all well. — E. R. Smoley, Secretary, 50 East Rd., Apt. 11E, Delray Beach, Fla. 33444

plant at Speyer. He is also looking forward to a visit with K. B. White at his chateau near Paris. Bink mentions the death on February 21 of John Alston Clark of Clarksdale, who started with the class of '18 but was delayed by the war and so graduated with us.

This brings us to news of other losses during the winter season. Our distinguished classmate, Art Radasch, died on February 20 at his home, 14 Captain Small Rd., South Yarmouth, Mass. Art had lived in Montclair, N.J., for 36 years prior to his retirement on Cape Cod. He was a chemical engineer at the Barrett Division of Allied Chemical before he entered the educational field as head of the chemical engineering department at Cooper Union School of Engineering in N.Y.C. He was co-author of a textbook on chemical engineering. A tribute by the faculty at Cooper Union deserves quoting: "Arthur Radasch was a strong man; strong in his opinions, strong in his leadership as department head, strong in his friendships, strong in his pride in achievements — by his students, associates, alma mater, himself. When President Humphreys appointed him Acting Dean of the School of Engineering in 1962, he was no stopgap or time killer, but a real acting dean in every sense of the word. He was a hard worker, a man of rigorous standards, honest, direct, forthright. He had a relish for life, a vigorous curiosity and enthusiasm, whether investigating a sauce perigord or family genealogy. These thoughts and sentiments are expressed as the unanimous feeling of the faculty of Engineering and Science." Art is survived by his wife, Katherine, a daughter and four grandchildren. The class will miss him very much.

I am indebted to Karl Bean, a neighbor of Art's in Yarmouthport, and Ed Burdell for the above information.

George R. Knight, '21, of Brockton, Mass., passed away on February 20, 1975.

Samuel Ruttenberg of New York City died on Feb. 18, 1973. . . . Jack Crowley of 200 Gaylord St., Denver, Colo., died on July 25, 1974. Jack formerly lived in Jupiter, Fla. No further details. — Harold Bugbee, Secretary, 21 Everell Rd., Winchester, Mass. 01890

21

This month's class notes should perhaps be labeled "Florida Edition." A goodly part of the news was garnered during your secretary's six-week sojourn in Florida, which included a number of luncheon dates and cocktail parties.

Our first contact after arriving in Sarasota was to call Claudia and Josh Crosby and invite them over to our apartment on Siesta Key for cocktails. Josh, as Assistant Secretary, has been faithful in supplying news for this column, in addition to his other duties as Secretary of the M.I.T. Club of Southwest Florida. We caught up with the news of numerous classmates in Florida and enjoyed the sociability of these two good friends. During the month of February, we had a number of luncheon dates with the Crosbys, and it was always fun. . . . One day we were inspired to walk one mile up Crescent Beach and call on Katherine and Laramon Randall at their beach-front condominium. We had last seen them at their cottage on Lake Winnepeaukee last sum-

mer. They both seemed to be in reasonably good health and enjoying life. . . . The Herbert Kaufmanns farther north on Siesta Key entertained the Crosbys, the Haywards and the Bob Felsenfelds at cocktails one evening. Herb and Millie are both active in Sarasota; Herb now serving as chairman of roads and bridges for the Siesta Key Assoc. Twice during our stay the local newspaper quoted Herb regarding the need to correct hazardous road conditions on Siesta Key. Herb is still a director of Rosario and flies to New York to attend board meetings.

Two weeks after our sociability at the Kaufmanns, Alice and Bob Felsenfeld came over for a social hour at the Haywards. Bob showed us a sample of expanded metal screening manufactured by his Exmet Corp. in Bridgeport, Conn. His company uses an English patent for expanding metals and Bob developed many applications, including metal in the silver batteries used by the astronauts in their flights to the moon. Four days later we had a telephone call from Herb Kaufmann with the shocking news that Bob Felsenfeld had a fatal heart attack early that morning (Feb. 21). He had had a severe heart attack a little over two years ago and only because the attack came while he was in the hospital, did he survive. Your Secretary feels a deep personal loss as his friendship with Bob goes back over 50 years to undergraduate days in the same classes in Course X. In his business career Bob worked in the research and development department for Sears Roebuck, later for R.C.A., and then founded the Exmet Corp. He was Chairman of Exmet and his son Peter Felsenfeld, '54, is President. The Felsenfelds were to have celebrated their 50th wedding anniversary this June. Our deep sympathy goes out to his wife Alice, their son Peter, and daughter Jane Fraser.

Learning that Betty and Dugald Jackson were driving down from Mt. Dora, Fla., on Feb. 4 to stay overnight in Sarasota, Josh Crosby set up arrangements for an M.I.T. '21 luncheon that day. Attending were the Jacksons, the Crosbys, Ruth and Ted Spitz, Beth and Whittier Spaulding, and the Haywards. The Spauldings invited everyone to come to their house afterwards and Bea and Tom Dutton, close neighbors, joined us there. An afternoon of conversation, followed by cocktails; the result: "a good time was had by all." Dug Jackson told of some of his activities in both world wars (he joined the class in our junior year) which he ended with the rank of Colonel. Ted Spitz, staying in Venice, Fla., for two months, tells us he is still involved in public works construction in Boston. Our hostess for the afternoon, Beth Spaulding, showed some of her artistry with shells from the Gulf. Also, adorning their walls are many of her fine paintings. In addition to these talents, she writes poetry.

Another luncheon in Sarasota involved Helga and Jim Parsons with cocktails beforehand at their beautiful bay view apartment. A month previous they had taken a cruise in the Caribbean which they characterized as "wonderful," and were then making plans to attend the Fiesta in Mexico. . . . Your Secretary was the guest of Whittier Spaulding one afternoon at the monthly members' meeting of the Mote Marine Laboratory on Siesta Key. Interesting talks were presented by the laboratory scientists on Red Tide research, neurobiology and

of catfish, estuarine ecology, and the biology and love life of sharks. After the meeting, the Haywards, Crosbys and Spauldings got together for cocktails.

With the assistance of **Phil Coffin** in Naples, Fla., and **Phil Payson** in Fort Myers, another '21 luncheon was set up on Feb. 20 in Fort Myers. We had hoped to see **Mich Bawden**, **Herb Gwynn**, and **Dick Windisch** of Naples at the luncheon, but for health reasons they were unable to attend. There were 15 of us on hand, however, including Edna and Phil Coffin, **Ed Delany** and his sister Frances Park, the Crosbys, the Spauldings, Graciela and **Helier Rodriguez** (who drove down from Tampa), Madeline and **Rufe Shaw**, Marion and **Phil Payson** and **Sumner Hayward**. We were sorry to learn that Kay Delany was in the hospital with heart trouble and hope she is back to normal by now. Phil and Edna Coffin went to Alaska last summer via the inland waterway and took a number of bus tours around this rugged country. "An exciting tour," said Phil.

A final luncheon before we ended our Florida vacation was arranged by Helier Rodriguez and **Elmer Campbell** at the Skyline Restaurant in St. Petersburg. There were 12 of us including Graciela and Helier Rodriguez, **Don Lyman**, Mildred and **Tom Bartram**, Muriel and **Vic Phaneuf**, Becky and Elmer Campbell, Pat and **Allen Adicks**, and yours truly. Vic Phaneuf entertained with several of his imitable stories. Don Lyman was shocked to hear of Bob Felsenfeld's death, having roomed with Bob at M.I.T.

On the way home to New Jersey, we swung over to the east coast of Florida and joined forces with Helen and **Scripps Booth** of Boca Raton for Sunday dinner. We reminisced about the lead roles Scripps had played in several Tech Shows. Even though we hadn't met in 50 years, Scripps was easily recognizable, but a little thinner on top. He worked for Cities Service in Boston for many years and in the last ten years of his business career worked for the government. He now does part-time tax work as a public accountant. Lorraine and **Arthur Wakeman** of Delray Beach also joined us for dinner to make a sextet. Art worked for many years with Kimberly Clark in Wisconsin, and has been a long-time consultant for the federal government on the paper industry, traveling all over the world. As a final bit of serendipity, I was thumbing through a copy of the February issue of the Gold Coast Pictorial in our motel room in Boca Raton, and suddenly there was a picture of Marjorie and **William Knoepke** staring up at me. The scene was the annual Snowflake Ball sponsored by the board of directors of the Fort Lauderdale Oral School for deaf children. The accompanying article said in part, "capturing the hearts of everyone there, were children from The Oral School who, though immersed in silence, sang Christmas Carols."

Alumni Fund envelopes provide a couple of scraps of news: **Richard Smith** of Chevy Chase, Md., writes that he sees **Elliott Roberts** occasionally. Elliott and his wife spent the Christmas season in Vienna, Austria. . . . **Dave Woodbury** writes that he lives quietly in Ogunquit, Maine with his wife and three cats. "We are both deputy directors of Civil Defense for York County. I still produce a science column in *Review of the News*, a small Boston publication. I have 24

books on science in the libraries, about one third of them still in print." . . . A letter from H. L. Elman, '60, to the secretary of his class tells of his marrying "Joan Carter, a tall, slim, blue-eyed, golden-haired, intelligent, sweet flutist." Her grandfather is **Donald Carter**, '21, of Glastonbury, Conn. How about a letter from you, Nick?

The list of deaths this month is soberingly long. Besides the one covered above, there were seven more: **Lucien G. Schlimgen**, Madison, Wisc., July 30, 1973; **E. Gideon Widell**, Nashville, Tenn., August 13, 1974; **Wallace C. Norling**, Brockton, Mass., August 19, 1974; **James Le Grand**, Denver, Colo., October 6, 1974; **Wilford Seitz**, Sandusky, Ohio, November 28, 1974; **Ralph E. Ferdinand**, Marshfield, Mass., December 23, 1974; and **Arthur A. Turner**, Boca Raton, Fla., January 8, 1975.

Schlimgen entered M.I.T. in our junior year after previously attending Notre Dame and the University of Wisconsin. He was president of Lucien Schlimgen, Inc. . . . Norling was Field Engineer for Blake and Knowles, East Cambridge, Mass., and was a 50-year Mason. . . . Le Grand also entered M.I.T. in our junior year after attending Marquette University. In his business career, he was an architect and structural engineer in Detroit, and later became structural engineer for McGraw Construction Co. in Middletown, Ohio. . . . Seitz joined our class in his sophomore year after preparing at Kenyon College. He was Chief Chemist for the American Crayon Co. in Sandusky, Ohio. . . . Ferdinand was active on the swimming team and in Tech Show as an undergraduate. He was president of the Joslin Showcase and Fixture Co. which he sold in 1958. Later he worked as procurement engineer for Bethlehem Steel in Quincy, Mass. "Fritz" was struck by a car on Dec. 11, and was in a coma until he died on Dec. 23, 1974. He is survived by his two sons, Paul and Warren. . . . Turner was a graduate of Boston English High School. He worked from 1932 to 1966 for the Carborundum Co. in Perth Amboy, N.J., and Niagara Falls. He became vice president and general manager of the refractories division of Carborundum.

The sympathy of the class is extended to the families of these men. — **Sumner Hayward**, Secretary, 224 Richards Rd., Ridgewood, N.J. 07450; **Josiah D. Crosby**, Assistant Secretary, 3310 Sheffield Circle, Sarasota, Fla. 33580; **Samuel E. Lunden**, Assistant Secretary, Lunden and Johnson, 453 South Spring St., Los Angeles, Calif.

22

Our hero of the month is **Parke Appel** who has enclosed recent letters from classmates. Parke is director of the M.I.T. Club of Southwest Florida and often sees **Al Powell**, **Rudolph Blatter**, **Bill Edmonds** and **John Starkweather**. . . . Classmates have written-in, some requesting our reunion just before Alumni Day and some later. Many are enthusiastic about the Spalding Inn Club. . . . **Larry Washington** has written from Palo Alto voting for the 55th Reunion. Also a vote from **Jack Hennessy**. . . . **Don Carpenter** of Mendenhall, Penn., has written of the favorable comment for the Class of 1922 endowed professorship and the Career Development Fund. He told about Margaret MacVicar talking to the Corporation regarding her undergraduate research

program. She has written Parke enclosing recent magazine articles and telling of her presentation. . . . **Dale D. Spoor** of Richmond is working diligently for contributions to the Alumni Fund and is getting excellent '22 responses to his appeal. Dale will check out the Spalding Inn for us this summer and may also take a boat trip through the islands to Alaska.

C. Hall Baker writes that he has stayed next door to the Spalding Inn and comments on the beauty of the scenery in this area. He is at Cape Elizabeth, Me., and will see us. . . .

. . . **Wilfrid M. Thomson** of Corona del Mar, Calif., prefers the reunion before Alumni Day and will be happy to attend, but hopes to see friends in other classes. They will visit their daughter at Vero Beach, Fla. . . . **Randall Spalding** of Whitefield has written that Marcy and Dorothea Eager were back for their 17th return vacation this year. They enjoy the lawn bowling and beautiful scenery. Randall hopes to be in Florida during this spring. He has told us about visits from Marion and **Norman Greene** and Frances and **Raymond Hewes**. . . . Marian and **Roy Stone** send Christmas greetings telling of their year of cruises and European travels. Also of their visits to attractions near Clearwater and family birthday parties. Grandchildren, both old and new, have pleased them and their concerts and community activities have kept them busy. They will visit the New York and Boston areas during this summer.

C. Yardley Chittick writes from North Conway, N.H., that he is doing patent work and is now town counsel for Wakefield. He suggests group bus transportation from Boston for those coming by air for our reunion. . . .

C. George Dandrow looks toward a post-Alumni Day reunion at Whitefield to enjoy review of activities. . . . **Aline and Ray Ellis** of Sarasota hope to be with us in '77 after visiting friends in Maine. . . . **Warren T. Ferguson** of Watertown prefers our reunion after Alumni Day for somewhat better weather. . . . **G. Dewey Godard** hopes to be with us in Whitefield. . . .

W. Raymond Hewes of Needham speaks with authority and enthusiasm about the Spalding Inn Club. . . . **William H. Mueser** of New York City will probably be with us in June and bring along his latest award and honors. . . .

Walter M. Saunders Jr. of Cape Elizabeth, Me., has written that our late **Frederick S. Blackall**'s grandson is getting his S.M. degree in metallurgy. His maternal grandfather, Grenville Hancock was in the class of 1917 and his mother worked at M.I.T. as a research chemist from 1945 to 1949. To carry out the family tradition, the thesis of S. F. Blackall IV is entitled "The Delivery and Casting of Semi-Solid Metals." Freddy's grandson was married in August, 1973, and presently lives in Watertown. . . . We were able to call **Oscar Horovitz** in Pompano Beach in March, finding from his lovely bride that he was on the golf course as usual. Oscar sent us a clipping from the *Fort Lauderdale News* of the many activities of Col. **Ray C. Burrus**, one of Hallandale's most involved citizens. Ray is still "a shining example of the value a retired person can make to his community." . . . **Milton M. Manshel** has sent a beautiful picture of the *Royal Viking Star* passing through the Panama Canal and regards from his cruise from San Francisco to Ft. Lauderdale in February and March.

We have received a letter from Evelyn T.

Walke of Tucson telling of the death of Col. Roger S. Walke in December, 10 years after retirement. Colonel Walke had worked as an electrical engineer with Stone and Webster, Gulf States and Virginia Electric Power in Richmond. He enlisted in the Air Force for four years and was overseas with the 8th Air Force, but returned to Virginia in 1946.

We were happy to hear from Rosco Sherbrooke of Cohasset. Ros has recently moved from their former 150-year-old home of 35 years down the street into their boat home at 311 Jerusalem Road 02025. They enjoy the continuous movement of ships and the lobstermen with their traps and fruit. They see species of ducks, geese and an occasional whistling swan on the Atlantic Fly-Way. He tells of their pretty little Buffleheads that dive to the bottom for food only to have a gull dive-bomb as they return to the surface. Their occasional "northeasters" with huge waves hit near their sun-deck and bounce on the ledge completely obliterating from view the 114-ft. Minot's Lighthouse. He claims relationship to Ross's Gull, seen off Newburyport, never before viewed in continental America as it breeds in Siberia. He says, "I must have some relation to him besides his name as he is also small, has red feet, a pink breast, and in summer displays a black ring around his neck."

The sympathy of our class is extended to the families of Ellsworth M. Wilson, Westerly, R.I.; Richard E. Donnelly, Chatham, Mass.; Charles D. MacKintosh, St. Petersburg, Fla.; Paul J. Choquette, Saundertown, R.I.; and Donald R. Waugh, Wolcott, Conn. . . . A late note adds our Treasurer, Everett W. Vilett to our losses. Ev was vacationing in Mexico with his wife. He had been a prominent member of the Short Hills, N.J., community for years, a former member of the Township Planning Board and past president of the Knollwood and Short Hills Civic Associations and the Old Guard. His entire business career was with Public Service Electric and Gas Co. and he was executive assistant to the president when he retired in 1968. Our sympathy goes to his family.

We hope to see you all at our mini-reunion in good health in June. — Whitworth Ferguson, Secretary, 333 Ellicott St., Buffalo, N.Y. 14203; Oscar Horovitz, Assistant Secretary, 3001 South Course Dr., Pompano Beach, Fla. 33060

23

Marge and Tom Rounds have recently returned from a South Pacific island tour which included Tahiti, New Zealand, Australia, Fiji, Samoa and Hawaii. Tom reports that the smaller islands were visually, at first hand, tropical paradises; New Zealand (south island) was glorious with terrific Alpine scenery; Australia was dynamic; but Hawaii (Waikiki, Oahu area) was just too crowded for comfort. Tom also said that it was good to be in summer weather during January and February. . . . Alan R. Allen writes that he has learned to control his cancer as well as his arthritis and feels so spry that he might show up at '23's 75th Reunion in 1998. (We will all be there to greet you, "Al", so don't let us down!)

Helen and Lem Tremaine sent a card from the Biltmore Hotel in Santa Barbara, Calif., stating that this was their last stop on



A. R. Holden, '23, Parke Appel, '22, and J. D. Crosby, '21 after the M.I.T. Club of S. W. Florida luncheon meeting in February.

a three-weeks' trip to California, from San Francisco to Palo Alto (with a side trip to Lake Tahoe), to Carmel, to Santa Barbara. . . . Leander H. Poor advises us that he has had several consulting jobs and that he and Mary Margaret finally made it to Bermuda last March. He keeps occupied with home activities including entertaining old friends from Australian experiences. . . . Raymond M. Meekins reports that he managed to move into a new house in Roanoke, Va., last April. He worked with the architect and supervised the construction. This year he will devote to landscaping the place, which is in the middle of interesting country. . . . Kenneth G. Merriam, '22, has sent to Tom Rounds about 50 black and white pictures of R.O.T.C. students taken at Fort Monroe, Va., in 1921. These pictures are small and are not glossy. Identification of those portrayed is completely lacking. Anyone interested in looking at these pictures may obtain them on loan from Thomas E. Rounds, 900 A Heritage Village, Southbury, Conn., 06488, or phone (203) 264-9351.

Joseph H. Cox died February 25, 1974. Born in 1893 in Newman Grove, Nebr., he married Leona Dietrich of Nebraska. He was employed by the Transmission Engineering Dept. of M.I.T., Big Creek lines of Southern California Edison Co., the 154-kilovolt lines of the Aluminum Co. of America, Mercury Arc Rectifiers, (manager of engineering), and Arnold Engineering Laboratories in Tullahoma, Tenn.

Carroll H. Deitrick died in July, 1973. In 1943 he was assigned as Colonel to the War Dept., Pentagon Bldg. In 1952 he was advanced to Major General. He retired as Commanding General of Ordnance Tank-Automotive Center in Detroit, Mich.

George Wakefield Gibb died July 11, 1973. He married Esther A. Jackson of Boston, and worked with Mason and Hamlin Piano Co. before joining, in 1941, Allis-Chalmers Manufacturing Co., of Hyde Park.

Roderick Bissell Jones died Mar. 25, 1974. He was born in Winsted, Conn., in 1898, received a B.A. degree from Yale in 1921, an M.S. in physics from M.I.T. in 1923, a Ph.D. in mathematical physics from Yale in 1929, and an LL.B. from Yale in 1931. A member of the Bar in Connecticut, he was president of the Beardsley Memorial Library; Corporation Winsted Savings Bank; and trustee of Winsted Memorial Hospital.

Arne Lier died January 1, 1975. He was born in Hamar, Norway in 1900, and married Astrid Hjordis of Oslo, Norway. He joined the Port of New York Authority and

became chief structural engineer, working on vehicular tunnels, bridges, terminals and airport structures.

Charles Harrison Lusk died November 4, 1974. Born in Newton Center, Mass., in 1901, he was a management consultant for S. S. Pierce and Co. of Boston, and the Protective Union of Worcester. He conducted his own business in Chicago, Ill.

George Wilbur Seymour died February 1, 1975. He was born in New York City in 1899. After graduation, he joined the E. I. duPont Co. as a research chemist. In 1959 George became chief of research for the Small Business Administration, Washington, D.C. During World War II he directed a \$1-per-year laboratory for Celanese on contract with the Army Chemical Warfare at Edgewood Arsenal.

Gilbert Whitehead died February 27, 1974. He was born in Emsworth, Penn., in 1893, and married Nanette Diana Walker of Toronto, Ontario. From 1929 to 1936 he was employed by the International Nickel Co. of Canada. Later he joined the H. A. Wendt and Co., Ltd. of Manila. From 1951 to 1961 he was with the Bethlehem Steel Co., and became a consulting engineer with them. After retirement he was appointed City Engineer in Prescott, Ariz.

I am sorry to report the following classmates have also died: Ernest L. Akerley on February 19, 1972; Lewis T. Batt on January 1, 1974; Clarence A. Braukman on Oct. 30, 1974; Monroe E. Epstein on Nov. 23, 1973. — James A. Pennypacker, Assistant Secretary, Long Hill Road, Essex, Conn. 06426

24

Your scribe is very grateful to Herb Stewart, your co-secretary, for compiling and editing the notes for these columns in the last two Review issues. Fearful that you many now recognize the current author and proceed little further, you should know of the singular honors bestowed on Herb.

On January 28, 1975 in New York at the Awards Luncheon Winter Meeting of the I.E.E.E. Power Engineering Society, he was presented the Wilbur M. Harbirshaw Award: "For significant contributions to transmission systems analysis and design, particularly protection, stability and control." It consists of a bronze medal, a certificate and \$1,000 and may be awarded each year to an individual who has made outstanding contributions to the field of Electrical Transmission and Distribution by the I.E.E.E. Board of Directors.

February 20, 1975, Herb was again honored at the annual Engineers' Week Luncheon in Boston as the thirty-third recipient of the Distinguished New England Engineer Award made to a living engineer, resident of New England, who by "outstanding achievement merits recognition of his accomplished works as well as his character by his fellow engineers of the New England states."

Herb came from London, England, at an early age and attended schools in Maine, receiving his S.B. and S.M. in 1925 at M.I.T. He joined Westinghouse in 1925 and switched to the N. E. Electric System in 1934 as Protection Engineer and retired in 1967 as the System's only senior engineer after a fruitful career of major projects, some of worldwide importance. He contributed prestigiously to the design of E.H.V. Transmission networks in New England in-

cluding studies for bringing Appalachian mine-mouth power to N.E. by means of 500 KV or 700 KV transmission and Canadian power to Massachusetts by high-voltage D.C. from Labrador. He is well known internationally, having served as U.S. representative on a number of committees of the International Conference of Large Electric High Tension Systems (CIGRE) which met in Europe. He is a fellow of I.E.E.E., a registered professional engineer, a member of Tau Beta Pi, and enthusiastic about year-round tennis for relaxation.

We have no report on **Nish Cornish's** 17th Annual Fiesta in Mexico, but three of us did take part in a talkathon with the attendees at the third 1924 Florida Fiesta in Clearwater, Fla. on Saturday March 1 — **Herb Stewart, Frank Shaw and Russ Ambach**. About 15 classmates and wives gathered at **Clint Conway's** hacienda and boasted that they were basking in the sun wearing shorts. Frank countered that one with, "So are we, but have our pants on." ... Lorene and **Paul Cardinal**, Jocky and **Phil Bates**, and Peg and **Pret Littlefield** had a mini-reunion January 29 in Naples, Fla., after Phil had attended an editors' meeting in Sarasota. After sipping and lunch, Naples-Booster Paul conducted an area sightseeing tour for them. (Real estate for sale, Paul?).

Alumni Fund envelopes have provided an international flavor this month. From Guadalajara, Mexico, **Rutilio Torres-Saravia** writes, "Salud! Russ — Give my best for all our classmates during 1975." ... **Blanchard D. Warren** says that he is on the move again, apparently from Oregon to Lake San Marcos, Calif., an adult community with many activities. "Sorry to miss the 50th Reunion — possibly see you next year. All five children and ten grandchildren doing well." ... 6000 miles east, in England, **George Knight** pens, "This has been a good winter over here in the south of England. Daffodils are now in bloom and there have been some kind of flowers blossoming since we arrived in early December. We don't get around as much as last year because petrol is about \$1.80 per imperial gallon or about \$1.60 per U.S. gallon. We make a point of getting out in the country once a week with lunch at an old English pub, but don't go so fast or so far. The rest of the time, Edith finds one project on top of another to keep me busy — mostly carpentry and painting. Surprising how much work one can find in a small cottage." They will return to Hingham, Mass., about May 15. ... And right near in Wellesley Hills, **Reginald B. Miner** gives us a quick review: "Retired 1964 as vice president, John Hancock Insurance Company; retired 1973 as trustee of Brookline Savings Bank." I would say the Reg predated the sad debacle of complete window glass replacement in the new John Hancock skyscraper, now about finished.

Jimmie Doolittle (retired) came into our living room on color TV on March 2 as a member of the board of directors of Mutual of Omaha. If he is an example of the protection and preservation offered by his company, a number of us have missed the boat. ... In a recent issue of Texaco's publication, *Dealer*, an article is prominently headed, "Lee Ludwig's Yankee Enterprise." **Leland O. Ludwig, Jr.** is pictured seated in his office in Houlton, Maine, calmly puffing his pipe. After graduating, Lud did a stint at

The Stanley Works and E. B. Badger & Sons in Boston. Returning to his native Houlton, he saw the possibilities for petroleum products in that wood-burning area and founded Petroleum Products, Inc. Having seen how Texaco gasoline put a Model T Ford up Corey Hill in Brookline, he became a Texaco distributor, which now manages 33 service outlets and supplies oil products to lumber, paper mills and potato growers.

We regretfully report the death of Lloyd J. Porter in Pompano Beach, Fla., on December 22, 1974. He prepared in Passaic, N.J., graduated in mechanical engineering, spent some time with Babcock & Wilcox, became a safety engineer for Travelers Insurance and went into the insurance business in Fort Lauderdale, Fla. The sympathy of the class is extended to Lloyd's wife and children.

Our treasurer, **Ray Lehrer**, writes our president, **Frank Shaw**, that he has closed the 1924 checking account at Harvard Trust Company and subsidized a check for \$50 which has raised to \$850 our deposit on hand with the Institute.

A visit to the M.I.T. Historical Collections, 265 Massachusetts Ave., Cambridge is strongly recommended. This young project (1971) with Warren A. Seamans, Director, bodes well to becoming an important part of the Institute with its priceless memorabilia of photographs, portraits, architectural theses and original patent models. The present budget is a meager \$45,000 and the restoration cost of one portrait averages \$350. Present space off campus is very limited. Your scribe, from personal observation, suggests financial support for enlargement would create a very visible, specific, memorial area on campus. — **Russel W. Ambach**, Secretary, 216 St. Paul St., Brookline, Mass. 02146; **Herbert R. Stewart**, Co-Secretary, 8 Pilgrim Rd., Waban, Mass. 02168

25

Reunion plans are going ahead at a great rate. I notice that I have been drafted to serve on the committee, so you will see my name among others appended to notices that you receive. **Jim Howard** and **Ed Kussmaul** are still doing the bulk of the work and it is a very good job. **Hollis Ware** informs me that he hopes to be with us for the 50th. I recently attended a meeting of the Alumni Council in the company of **Jim Howard, Ed Kussmaul and Doc Foster**.

A letter from Doc gave me some news about classmates who now reside on Cape Cod. **Ken Proctor** keeps busy with such tasks as house painting and gardening. Doc says that Ken has the best lawn on his street. He recently visited relatives in Alabama, and is a member of the Hyannis Retired Men's Club. ... **Archer Nickerson** who retired from the Fore River Shipyards in 1964 is now in Duxbury. Arch is able to appreciate many of the things the Cape is noted for, such as clams, mussels and seafoods of many kinds. He does consulting work on the design of rigs for offshore drilling and still works on the restoration of antique clocks. The last, he states, would drive him nuts if he did it full time. ... **Ralph Norton** who retired from active business in 1965 is now a resident of Buzzards Bay.

A copy of a letter from **Kam Kametani** indicated that he and his wife, Hisako, after

attending the reunion will continue a trip around the world, going to Europe and Hong Kong on their way to Tokyo. . . . A letter from **Joseph Russell** of Houston, Texas, giving me a change of address says that he hopes to be with us at the 50th. . . . **Milt Salzman** went on a trip to Germany, Switzerland and the Austrian Alps. He too will be reunion bound. . . . I received a very interesting letter from **Geoff Roberts** in England. He describes an English television program covering the enthronement of the new Archbishop of Canterbury. Geoff had of course been to Canterbury and the place was familiar to him. Dignitaries were there from all over the world, but the most interesting part was the description of the cathedral: the stained glass windows and the high columns. Alas the church is being attacked by atmospheric corrosion and 3.5 million pounds will be needed for repairs. All of this must be solicited. His letter made me relive some English history and the reading of Chaucer's *Canterbury Tales*. A grand letter.

I am grieved to report the passing of several classmates: **Peter Anastos** of Jamaica Plain, Mass., on Jan. 17, 1971; **Robert Anderson** of San Antonio, Texas, on May 16, 1974; **S. A. Townsend** of Los Angeles, Calif., on Aug. 13, 1974; and **Henry M. Lyons** of Sunapee, N.H., on Aug. 16, 1974. — **E. Willard Gardiner**, Secretary, 53 Foster Street, Cambridge, Mass. 02138

26

Perhaps we should start these notes "If you are reading this you are alive," but better still we have a terse but informative note from classmate **William Sackville**: "Class of 1926 — still alive at 83, W.S." These preliminaries because of the large number of deaths we must report this month. But first — today at Pigeon Cove is a day to be alive. It's mid-March with snow on the ground and not melting, but there's not a cloud in the sky and the air is invigorating. We did not realize all this until it was brought to our attention on a before-breakfast walk with our collie, Heather. We met an elderly lady (about our age) also taking an early morning stroll and she exclaimed, "Isn't it a lovely morning" and suddenly I realized how nice it really was. So saying, with the sun pouring in and the ocean below providing a rhythmic murmur, we plunge in (not in the ocean).

A recent formal announcement of **Wick Eddy's** passing caused us to write to his widow for more information and we quote from her letter: "Wick took an early retirement from Texas Gulf and had four happy years pursuing amateur forestry in Vermont. When he suffered a heart attack and the beginning of Parkinson's, we started a trek to warmer climate, by way of four years back in Stamford, Conn., one year in rural Sussex County, N.J., and finally arrived in Florida in 1972. He enjoyed the two years of balmy weather, keeping busy with his hobby of stamps and even golf, although his failing health slowed him down considerably.

"Wick was always very proud of his M.I.T. connection and the class of 1926. On his behalf, I send you all very best wishes." We too were proud of our loyal classmate who had never missed a reunion.

Bob Dawes has advised us of the death of **John Fletcher** in late January of lung cancer. John's widow Rachel had sent Bob this clipping from the January 22, 1975

Naples [Fla.] News: John Gill Fletcher, 70, a retired Lt. Col., residing in Newport News, Va., died Tuesday in Naples. He was a six-year winter resident of Naples and a member of the Sons of the American Revolution. He was a life master of the American Contract Bridge League, a member of the American Institute of Chemists, and he served with the U.S. Army during World War II.

Evelyn Dawes also happened to read about an architectural classmate and we quote: "Sebring, Fla. **George Vernon Steele**, '71, and his wife, Elinor (Fairfield) Steele, 74, of Dedham, Mass., were killed yesterday [February 24, 1975] in a car-truck collision. Mr. Steele was the president and treasurer of Roach and Craven, Inc., one of Boston's oldest interior decorating firms."

Another clipping from the Winchester, Mass. Star tells of the death on January 1 of **Frank Toperzer**. Frank had operated as a consulting engineer on his own for the past 25 years. . . . A report from the Alumni Register states that **Arthur Baird** died in Los Angeles about a year ago. . . . Also from the Alumni Register we learn that **Frank Strickland** of Seattle (who attended our last reunion) died a year ago.

With all that distressing news it is great to have a spirited letter from **Tony Gabrenas** who is over 75 and still based in Miami. Knowing of my interest in sailing, Tony sent along some very interesting clippings on the S.O.R.C. Races. Tony also tells of dropping in on **Gordon Spear** in Pompano Beach: "No one was home but as I was about to leave, Mr. Spear with charming Mrs. Spear came in the driveway in his super padded Caddy. He invited me in and we chatted about the good old days at M.I.T. I asked why we did not see him at the South Florida M.I.T. Club gatherings and he apparently does not enjoy driving on Florida's congested highways. . . . An Arizona note from **John Longyear**: "Gay and I go to Tucson in the winter where maturing is more tolerable but I still enjoy tending the Dearborn (Mich.) herb garden in the Summer, John." . . . A card from **Bill Meehan** in Indonesia tells that while he is still planning director for the University of Massachusetts, he manages a trip such as the current one to the South Pacific.

There are several more notes from active classmates but Heather and I want to get out and absorb some more of this "lovely day." With an expression of sympathy from the class to the families of the many classmates who will not be at our next reunion, we end with a message from **Al Entwistle** of Louisville, who says: "See you at the 50th." It won't be long now and cherio! — **George Warren Smith**, P.O. Box 506, Pigeon Cove, Mass. 01966

27

It's a little hard to concentrate on class notes on this Sunday afternoon in March, as I sit down to write. Last night we went to a concert of our local symphony and heard Beethoven's *Ninth*, and the theme from the "Song of Joy" is still ringing in my head. Can't remember the last time I heard a live performance of this massive work — almost 200 instrumentalists and vocalists — and it renews my interest in building up the orchestra, in spite of the same recurring musical and financial problems year after year.

Joe Harris writes from Mystic, Conn., that since their long trip in 1973 on the Orient Overseas Line, he and Ann have not been any farther from home than Bermuda, which he highly recommends if you catch good weather. He is keeping up his interest in SCORE, which he also highly recommends, regardless of the weather. . . .

Frank Connolly writes a cryptic note telling me that he has just returned home from a month in the hospital, and that the doctor tells him he is going to be fine. . . . **Ed Cahill**, who was a petroleum geologist until he retired, is doing some fieldwork in western Kentucky on a waterflood project, and is worrying that the army engineers may decide to flood out the stripper wells in the area with the new Uniontown Dam on the Ohio River. . . . **Harold Edgerton** is back in the news with a report that the 400-print photography exhibit, "Photography U.S.A.," now being circulated in eastern European countries by the U.S.I.A., includes his well-known photo of a bullet emerging from an apple through which it has been fired.

There is one obit to report this month. **Leiland D. Whitgrove**, U.S.N. Ret., died in September, 1974, at San Luis Rey, Calif. — **Joseph H. Melhado**, Secretary, 24 Rodney Rd., Scarsdale, N.Y. 10583

28

René Simard reports that his health is much better since he had a bleeding duodenal ulcer removed. He is now free of diet restrictions and plays tennis an hour each day except on weekends — this keeps him fit. He and Pam intend to be in Cambridge for the 50th. . . . Among the several Christmas newsletters we normally receive each year, the one from Louise and **Ernie Knight** is usually outstanding. This year was no exception. The letter was not prepared and sent until well into the new year because the Knights were away on another of their freighter cruises. They wrote: "Having become addicted to freighter travel it was inevitable that we indulge in another. Having been to the Pacific in 1969 and the Mediterranean in 1972, we chose to return to the Orient. The American Mail Line offers what they call a 'grab bag' voyage wherein there is no firm knowledge of the itinerary until shortly before departure and subject to change en route." The trip turned out to be 1800 miles in length and of 55 days duration. During that time the passengers lived comfortably, ate well aboard ship and visited ashore at all ports of call. An added feature of interest was a trans-Canada rail trip from Raymond, Maine to the West Coast via Canadian Pacific.

From **Myron Helme** we have this note: "In an attempt to keep our medical problems under control and to 'hang in there' for the 50th, Elsie and I moved October 1 to Shadow Lake Village, an adult condominium at Claremont Court, Red Bank, N.J., and we love it. There is a nine-hole golf course, fishing, boating and a swimming pool. We spent a wonderful two weeks in Hawaii just before Christmas. Regards to all!" Just before going to press we received another letter with very good news from Myron, in which he says: "Thanks to cobalt-60 and other medical, scientific and religious miracles, my malignancy which showed up in 1971 is being kept under con-

trol and Elsie and I are looking forward to the big 50th."

We also have these brief notes: **Gerry MacGillivray** talked with **Jim Donovan** by telephone. Gerry says that his son is doing very well as a test pilot for the Navy. . . . **Judith (Mrs. Ben) Miller** is planning a trip to Israel for late March. . . . **Iris (Mrs. Ermanno) Basilio** has recently moved to a new address in New York City. . . . **John Robinson** expects to retire in early 1976 from government service and hopes then to do private consulting.

The Class of '28 telethon was held on February 6. The following group assembled at the Alumni office to make the calls: **Jim Donovan**, **Carney Goldberg**, **Dick Rubin**, **Gus Solomons**, **Will Tibbets**, Ruth and **Abe Woolf**, Florence and **Walter Smith**. In the course of the evening we talked with 82 classmates (or wives). We enjoyed chatting with so many classmates and most responded with a pledge toward the 50-year class gift. Ruth's call to **George Bernat** prompted an enthusiastic letter from George expressing his intention to make a very generous donation over the next three years.

With deep regret we must report at this time the deaths of three classmates. **Kenneth L. Conger** died on March 22, 1974 following long illness. He was retired from General Electric Co. where he was an industrial engineer at the Lynn, Mass. plant. Besides his wife, Esther, he left a son and daughter. Our sympathy has been expressed to the family.

Harold K. Gold died on June 2, 1970. Harold was a meteorologist for the U.S. Weather Service in Washington, D. C. Upon retirement he became technical supervisor for the American Meteorological Society Translation Service in Cambridge, Mass. The latter post was by invitation and a consequence of Harold's interest and competence in languages. We talked with his wife Sarah and expressed sympathy on behalf of the class.

Charles W. Ricker, Jr. died on July 4, 1974. Our records show that Chuck had been assistant chief equipment engineer for the Chicago Transit Authority prior to his retirement. He and his wife Emily made their home in Evanston, Ill. To his family we extend our heartfelt sympathy. — **Walter J. Smith**, Secretary, 37 Dix Street, Winchester, Mass. 01890

29

John D. McCaskey had a mini-reunion last September with two other '29ers, totally unplanned, while on his way home from trout fishing in Canada at the home of **Bill Aldrich** in Billings, Mont. **Gus Stein**, who was on his way from his home in Florida to see his daughter in California, dropped in the same evening unannounced. "Of the four original 1929 'Dekes,'" he continues, "three of us were together. Of course we called **Wally Gale**, the fourth member."

Brief note from **Norman V. Ballou**: "We like living in the woods, quietly, and feeding the birds and enjoy the natural beauty that surrounds us. Not living in the city, we agree with Horace: 'Carpe diem quam minime posterum.' Sorry, my high school Latin is not good enough to give you the translation. Christmas greetings from **Ed Roche** reads, 'Dear Karnig: Cheerful holiday greetings to

you. Should you be looking for another winter wonderland, other than what you have in New Hampshire, come to the western part of New York, where we are, and see beautiful snow flurries, snow showers and snow squalls caused by Lake Erie. Trust that you, as well as the rest of the officers of the class are well. Sorry to have missed the 45th, but God willing, we are planning to attend the 50th."

A letter from **Paul S. Baker** reads, "We sure had a good time at the reunion with all the activities. It was especially generous of the Wilsons to have us for cocktails and buffet, and arrange transportation to and from Pops. We also enjoyed sitting with you and your wife Helen at the concert. Our trip to the XVI International Orienteering Congress in Canberra in August was interesting and enjoyable. On the way over, we stopped off to see our daughter at Lake Tahoe and Berkeley. On the way back, we had a week in New Zealand and several days in Fiji. Regards to all in which Kay joins me."

Since his retirement in 1971, **John G. Howell** considers himself fortunate being able to stay alive professionally by doing some consulting work and keeping up his interest. He serves on several civic committees and numerous other projects which keep him busy. His hobbies include travel, photography, wood-working and writing. . . . A brief note from **Rolf A. Zurwelle** reads, "Sorry we could not make the 45th Reunion because of my business and farming." . . . A letter written by **E. Neal Wells** to **Frank Mead** and Mary, was sent to me to use in the class notes. Here are some parts of it: "We are well and sincerely hope that you are too. The old year ended sadly for me as I went to Massachusetts for a final goodbye to my mother, after her many years of convalescence. However, I spent New Year's Eve and the day after happier with my grandchildren in Wellesley. Mid-May and June, we headed north to visit friends and relatives of Helen in Pennsylvania and on to Cape Cod for the 45th Reunion. Helen and I had lunch with Day and **Larry Moses** in Sarasota en route to Marco Island for the Florida Planning and Zoning Association Convention."

Anthony Standen has retired professionally, but keeps himself busy teaching math at the local public schools, which include classes for both bright students as well as slow ones. He is also doing some lecturing on Astrology. . . . **Charles J. Custer** has been retired from Bell Telephone Laboratories since 1972 after 43 years of service. His retirement celebration also marked his 65th birthday. "We sold our house in Andover," he continues, "and moved to an apartment in the same town. In the spring of 1973, my wife Mildred and I drove to the Pacific coast. We went to Seattle, Wash. by way of Denver, Salt Lake City, Yellowstone National Park and to San Diego. On our way home, we visited the Grand Canyon, logging over 10,000 miles. We hope to repeat the trip at some future time to see the things we missed. Doing all this traveling, which also included Florida in the recent past, Andover still looks good as a home to come to for both of us."

Harold M. Weddle has sent a "thank you" note for receiving a birthday card from the class of 1929. He still thinks that San Diego in general and "Rancho Bernardo" in particular is the choice location for retire-

ment; a fact that he does not wish to publicize too much in fear of an influx of retirees coming in droves and overcrowding the golf courses.

Kenneth G. Garside is semi-retired but he is teaching a course on the environment from an ecological point of view at St. Andrew's Episcopal School in Boca Raton, Fla. He also does psychological counseling. His activities include camping and hiking. . . . **Harold W. Straat** has sent a note as follows: "Though I have been retired for two years, I still do some consulting one day a week for the company I have been associated with. I spend some time at my vacation home on Keuka Lake (N.Y.) and on many a weekend I am a carpenter, electrician, plumber or whatever else that is needed. I am also helping my son-in-law build a large addition to his house. My wife and I have been very busy helping others in many ways which gives us a great satisfaction and pleasure."

A note from **Nicholaus L. Harms** reads, "Many thanks for your thoughtful birthday card, marking my 67th year. We have just returned from a 10-week tour of the Far East, comprising of Japan, Taiwan, Thailand, the Philippines, Singapore and Hong Kong. It was my wife's first trip to that part of the world, and for practical purposes, mine also, as my previous trips had been strictly on business. We had a wonderful time, despite the high cost of everything, especially in Japan." — **Karnig S. Dinjian**, Secretary, 6 Plaice Cove, Hampton, N.H. 03842

30

This month we have new retirement reports from two classmates and "progress" reports from two other retirees. **Ralph Scott** retired as of December 31, 1974 as chairman of the board of Osborn Engineering Co. in Cleveland. He will continue to live in Parma, Ohio, and will be retained as a consultant to Osborn. . . . **Bill Spahr** retired from Metropolitan Life in April, 1973. He is continuing to live in Smithtown, N.Y., where he is a member of the village planning board. The Spahrs have two daughters and a son, Jonathan, who is in the navy on the S.S. Saratoga in the Mediterranean. Bill reports having seen **Ted Green**, who is living in Lake Chautauqua, N.Y., about two years ago. . . . **Ted Riehl** who retired from Goodyear in 1971, is living in Tucson, Ariz., and reports that "retirement is great and living here where you can get out all year round makes it more pleasant." . . . **Greg Smith** could well be our most active retiree. In addition to the activities previously reported in the notes, he is spending two to three days a week at M.I.T. on the Undergraduate Research Opportunities Program (UROP) which he describes as a very exciting program. He is also a chairman of the Technology Review Advisory Board and of the M.I.T. Corporation Joint Advisory Committee, as well as being on two of the M.I.T. visiting committees. Greg reports that he is "enjoying retirement but can't learn to say 'no' when asked to do my bit. M.I.T. is a thrilling school, it deserves all we can do for it. The financial crunch on M.I.T. is horrendous. If this sounds like a hope that we will 'bleed' a bit for M.I.T. during our future it is just that."

C. Haskell Small, Col. U.S.A.R. (Ret.) is another classmate with an impressive list of

activities. Haskell has been in the real estate, property management and investment business in Washington, D.C. for many years. He is a treasurer of the Behrend Foundation and a director of the First National Bank of Washington. His service as Alumni Fund chairman for the District of Columbia and his activities in U.S.O., the Washington Opera Society, the Arts Club of Washington, and various Hebrew organizations have previously been noted in this space. He is also president of the Baroque Arts Society which sponsors the Baroque Arts Orchestra, a member of the Executive Committee of the National Choral Foundation which sponsors the Paul Hill Choral; a board member of the National Childrens' Center, Columbia Lighthouse for the Blind, and Metropolitan Police Boys' Club; and historian of the Woodmont Country Club. His hobbies include collecting phonograph records and he has one of the finest and most comprehensive record collections. Also for the past few years he has helped the wrestling team of American University by taking movies of their matches and then using them for visual education. The Smalls have two children, a daughter, Sherry, and a son, Haskell B.

Allen Shepherd is a consulting engineer for Amtel, Inc. with laboratories at Madison, Inc., Lincoln, R.I. Allen recently returned from an East Asian trip which included a cruise from Singapore through the islands of Malaysia and Indonesia, with a visit to Bali and exploration of the megalithic culture of the island of Nias. The Shepherds have a son, Allen III, who has an A.B. from Harvard, an M.A. from Brown, and a Ph.D. from the University of Pennsylvania. He is Professor of English at University of Vermont, specializing in modern American literature. His essays and short stories have been published in this country, Europe and the Far East. . . . **Elizabeth Rossman Everett** and her family have recently returned to New York after "an interesting sojourn in Washington with the Maritime Administration." Her husband Ted will be counsel to the law firm of Breed, Abbott and Morgan. Elizabeth's son and daughter-in-law will both complete the requirements for a Ph.D. this year. "A big year for the Everetts!"

We have at hand a note that **Jack Bloom** died on December 16, 1973. According to my records, Jack retired from his job as a U.S. Patent Examiner about ten years ago and went to live in Bonita Springs, Fla., where he was living at the time of his death. Unfortunately, no further details are available. — **Gordon K. Lister**, Secretary, 530 Fifth Avenue, New York, N.Y. 10036

31

While in Stuttgart, Germany, a few months ago, I had the pleasure of seeing **Bill Stellrecht** and his new wife for dinner. By this time, they have left for a vacation in Egypt and hope to be in America again around May of next year. Both Bill and his wife looked fine and his second marriage (after his first wife died) seems to be a very happy one. . . . **Ed Goodman** writes that he is retiring (oops, he retired) on January 1, 1975 after 41 years with Sprague Electric. He was Manager of Foreign Plants Engineering Liaison for the last five years. Ed says that he would like to see any and all of his old friends. . . . Word from **Al Kuhnel** tells of his

retirement at the end of 1973. He and his wife, Eleanor, moved to a country home in Santa Rosa where the climate permits them to enjoy their principal hobby of gardening all year. . . . **Charles Schroedor**, retired as of July 1, 1974 from Thomas Lipton after 31 years in research.

As a class we are pleased to learn that **Howie Richardson**, our own class president, has been nominated for President of the Alumni Association. . . . Jean and **Claude Machen** have offered their home in Wellesley, Mass., as the locus for a cocktail party and clambake on Saturday afternoon, June 7, if there is enough interest. It would top off the Alumni Weekend activities and be a pleasant social affair and planning session for our 45th in June next year. The expenses would be in the \$7.50 to \$10.00 range per person and we need your early expression of interest to encourage further planning. A note, postcard or telephone call (617-332-8354) to **John Swanton** while you're thinking of it right now would be most appropriate. Details will go out to all expressing interest.

Larry Barnard had a recent note from Elenor and **Joe Buswell**: "We bought a two-bedroom two-bath patio apartment, so have lots of room for you when you drop by any time between October 1 through April. Our address is 14038 111th Ave., Sun City, Ariz. 85351. From May 1 thru September we plan to be at our trailer at Jefferson Beach, where our address is Star Route Box 623A, Kingston, Wash. 98346." Since Joe has retired from the Army Engineers they have been almost constant travelers. They were at our class mini-reunion at Mexico City in 1973.

Paul Austin, '16, very thoughtfully sent me an obituary notice telling of **J. Howard Arnold**'s death, probably early in February. Our deepest sympathy to his family. . . . Word has also been received of **Marshall Andelman**'s death on January 2, 1975 at Peter Bent Brigham Hospital. After graduation from Tech in '31, he graduated from Boston University School of Law in 1934. During World War II, he was a captain in the Army, serving in the division of chemical warfare and later in the offices of the judge advocate. Marshall was an attorney for more than 40 years. Condolences to his family.

Within a few days after writing these notes (March 5, 1975), Sally and I will be heading for the Bahamas for few days and then on to Mexico for the Fiesta. Hope we meet some of you there. — **Edwin S. Warden**, Secretary, 35 Minute Man Hill, Westport, Conn. 06880; **Ben W. Steverman**, Assistant Secretary, 260 Morrison Drive, Pittsburgh, Penn. 15216; **John R. Swanton**, Assistant Secretary, 27 George St., Newton, Mass. 02158

32

John Lawrence, board chairman and chief executive officer of Dresser Industries, Inc., since 1962, was recently reelected a director of National Life Insurance Co. of Vermont. John has also been Chairman of the Board and Federal Reserve Agent of the Federal Reserve Bank of Dallas. Before moving to Dallas and Dresser Industries as Executive Vice President in 1957, he was with Jones and Lamson Machine Co., Springfield, Vt.; SKF Industries, Inc.,

Philadelphia, and Joy Manufacturing Co., Pittsburgh. . . . **Rocco A. Petrone**, Associate Administrator, N.A.S.A., was the recipient of the Louis W. Hill Space Transportation Award at the annual meeting of the American Institute of Aeronautics and Astronautics in Washington, D.C., February 26, 1975. The presentation was made "for distinguished contributions to space flight technology through his engineering excellence in launch operations, and outstanding managerial skills in directing the last six highly successful Apollo missions for the scientific exploration of the moon and lunar environment." . . . **John A. Fellows** continues his full-time consulting work with the American Society for Metals, in an editorial capacity, preparing Volume #10 of the *Metals Handbook*, due for publication in September, 1975. . . . **Bob Follansbee** retired in February, 1974, as chief engineer of the Portland-Montreal Pipe Line System and remains active as a part-time consultant, specializing in oil marine terminals and pipelines.

James A. Beam reports in with a delightful calling card, listing his vocations and avocations, some 30-odd, under the pixie summary, "Collector of Friends, Clocks and Old Tools." Mt. Vernon, Ohio, must have excellent mail service to support his roster of activities: . . . My favorite correspondent, **Jim Harper**, had a real great surprise awaiting me when I recently returned from a month in Florida. Jim's report on classmate activities in the D.C., Maryland, and Virginia areas is submitted verbatim. . . . **Joe Paul** still heads up Paul Brothers, Oldsmobile dealers in the Washington, D.C. area. He says these days of rebates in the auto sales business make it a new ball game. Paul is very active in civic affairs, including the executive committee of the Red Cross with emphasis on disaster relief, Rotary Club membership, serving as dean in his Episcopal Church and being an avid golfer with out-of-town golfing ventures.

Howard Lenderking has now retired after over 30 years as an industrial engineer with the DuPont nylon plant at Martinsville in southern Virginia. His son is with I.B.M., and Howard now has four grandchildren in North Carolina and New York. Last year Howard and his wife took a boat trip on the Rhine River, visited Switzerland and sojourned at the foot of Mont Blanc. . . . **Robert Loeb** retired some years ago from Martin-Marietta. Now that his daughter has graduated from college, Bob and his wife are traveling to many points in the U.S.A. His residence is in Lutherville, Md. . . . **George W. MacClintock**, who was in the civil engineering course at M.I.T., now has retired as minister of the Church of the Epiphany in Danville, Va. His son is in the University of Virginia Law School and his daughter is a student in a college at Danville. George is more active than ever in his hobby of stamp collecting. While he was originally from Massachusetts he now has an admirable deep-southern accent. He is a Chamber of Commerce booster, and assures us that Danville is really becoming a leader in tobacco and textile mill processing.

Christian Grosser, a mechanical engineering student at M.I.T., is still in private practice in machine design and product reliability in Richmond, Va. While most of his clientele is Virginia-based, he has extended his business to international scope for pat-

ents and legal aspects thereof. He remains very busy, but still keeps tabs on his five children and four grandchildren. . . . While some of us have supposed that college professors lead a rather quiet and sedentary existence, **Herbert Neustadt** still supplements his life as electronics instructor at the U.S. Naval Academy, Annapolis, Md., with tennis and swimming. In addition he sails yawls from the Naval Academy in the bay near his Annapolis residence. The Neustadts have three children. . . . **Henry Worcester**, Annapolis, Md., owns race horses and was again at the races when we called him recently. Even with this enviable avocation, he still has time to manage and operate about 15 laundry and dry cleaning plants in Maryland. . . . **C. Vance Hale**, who took mechanical engineering at Tech, retired last year from Noland Plumbing and Heating Co., in Newport News, Va. He has one son in college and plans a trip to Florida this June. He still plays a lot of golf — keeps his handicap a secret — but now in retirement has started gardening on a big scale, with special watering devices. . . . That's Jim's report and your Secretary hopes it will serve to inspire more of the same from other parts of the globe about your doings and activities.

The sad necrology from this month's alumni records contains the following information: **Arthur Y. Moy**, July, 1968; **Samuel T. Stueland**, May 7, 1974; **Leo P. Leino**, January 14, 1975. Our deepest sympathy goes to their respective families and friends. — **John W. Flatley**, Secretary, 6652 32nd Street N.W., Washington, D.C. 20015

33

Top billing this time goes to a rather small class reunion at 1079. January 30, 1975 saw three classmates, complete with wives, get together for cocktails and dinner: **Bob Heggie** with his Florie; **George Henning** and Lucy; and Warren and his Leona. Both Bob and George came down from Palm Beach. Bob lives there and George was visiting. Now, fellas, this was an event; the first time anyone has taken advantage of our long-time-standing invite. We made the most of it, with discussions, observations, and perhaps some argument. The Hennings have three daughters, now all married, and the Heggies have two daughters. The elder daughter is married and lives in Cincinnati, where her husband is a TV announcer, among other things; their younger daughter is also married, to an M.D., and they live in Saco, Maine. The Heggies expect to visit Mexico this spring, and are sure that the visit will not coincide with the Fiesta.

These Fund capsules came in too late to classify last time around: **Maff Faulkner** reports that he and Connie have spent the last four months (to Dec.) traveling just about all over — Europe, South Africa, Australia, and Japan, studying the "supply and demand" for uranium. Four months out of a suitcase was arduous, but fun, and they will be more than content to vegetate for a bit. . . . **Muriel B. Wilbur** writes that she is professor and coordinator of healthcare administration at Babson College, Wellesley. (We bow to our coed). . . . **Stanley Brown** allows that he is using up a lot of the long green, what with his daughter's studies at the New England Conservatory of Music. Golly, I'd like to have a daughter that young,



Bob Heggie, Florie Heggie, Lucy Henning, Leona Henderson, and George Henning.

Stan.... **Fred Walker**, retired in Denver, allows that he spends a lot of time visiting friends and relatives, and is faithful in his exercises that are beneficial to his ailing heart, and in general care of his wife's and his own health.

Louis Alpert and Bea had just returned from a three week trip to Israel, Vienna, and Amsterdam. You could have done that in three days, Louis; where else did you stop? Louis, as is common, found rather wild inflation all over. Thanks, sir! ... **Bill Pleasants** is still with Daniel Construction Co. of Greenville, N.C., as project manager in Mexico, Brazil, Puerto Rico et al. In Mexico, Bill visited and studied the Mayan ruins at Palenque, and was "checking on Erich Von Daniken's report in his book, *Chariots of the Gods*." Bill's observations on Erich Von Daniken's work are rather unfavorable. Anyone interested might well contact Bill, who is willing to accommodate.

Golly, here's a fella who wrote me once before, about ten years ago: **J. H. Merritt**, the Liberty Mutual Insurance Co. mogul. Jim is retired, has moved to California (May, 1974), in the San Francisco area, to be near the children and grandchildren and to enjoy the north California climate. Thanks, Jim; did you send in a change of address? If so, I do not have it. ... **C. T. Newton** writes that he is retiring again (for the third time), and is doing some consulting, and a lot of world traveling. Colonel, you are now getting right back home, and are living within a couple of miles of my son, Senator Warren S. ... **Harry Summer** comes through with holiday greetings (Xmas), for which we are most thankful. Harry regrets **Cal Mohr**'s leaving the Chicago area.

Walt Skees sends along an article: "Why so many Americans retire abroad." (I was not aware of so many.) Walt says that he is involved with a dozen land boundary cases in the Bahamas Supreme Court, and he does his own title and documentary searches. ... Now comes a post card from **Slick Henderson**, written and mailed in South Africa. He says that he has the whole family with him: four children, two sons-in-law, and one grandchild. Slick retired from Sverdup and Parcel as of January 1, and the trip is a real family vacation. The card shows the Blue Train, which runs between Johannesburg and Cape Town; they used it for the first leg of the journey. Slick "hates to have to return to winter." Some of us don't have to return. Thanks a million, Slick and Bess.

A card from **Prentiss Lobdell**, says that he and Marg expect to take in the Fiesta, in

Mexico this year also. ... We have a card from the world traveler, **Mal Mayer**, who says that they are on a caravan trip through Mexico in their Airstream. The littlest daughter of Daph and **Beau Whitton** was married on December 28; the last of the three children have flown the coop, and that leaves the Whittons a chance to do more traveling. They intend to visit Jacksonville to see Beau's sister, and next fall to make their first trip to England. This Beau appears to be quite a reader; he has no time at all to start his ranch, yet he is reading two books about the presidency, whatever that might be. Also, the card says that Daphne has just had her second successful cataract operation. Good! That leaves me with only two to go, myself, (and this I mean) probably within one to two years. Beau, you are a joy. All you have to do now, is find 15-20 Angus cows, and, the bull that complements them (if you choose well). Further, I want in on this, without my usual fee. Thanks a whole lot, friend.

We have a very fine letter from Christine **Norris**, who tells us that **Emmy** has suffered a rather severe stroke, and, fortunately, he has been making a good recovery. Christine is very optimistic, and reports that Emmy is getting far better than average care, at the Rockingham County Home, where a very unique program for stroke victims has been in successful operation for a long time. This unit is somewhat obscure, and asks for no publicity, but, they are doing a bang-up job, especially with stroke cases. For those who care to drop Emmy a line, the address is: Box 145, Newcastle, N.H. 03854. Fellas, put yourselves in Emmy's place and see how you might feel about a note from a classmate. And, Emmy, we all wish you well, and the best. And, Christine, thanks for such a fine letter, written by an understanding, smart girl. No address changes this time, so, many next.

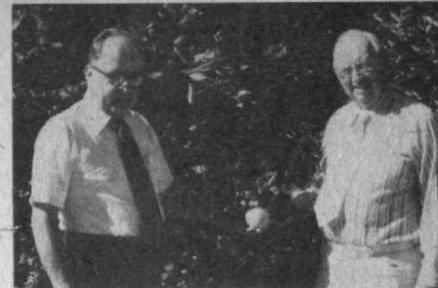
Kirtland Manley has passed away on Jan. 14 in South Orange, N.J. ... I received a letter from **Jim Turner** telling us that **Charlie Bell** passed away suddenly on March 9. Jim's letter included notices from two Rhode Island papers, but no details of Charlie's death. We will write Mrs. Bell for our class as usual. This gets awfully close to me as Charlie was our good friend even as a student.

This is the last column written with the Florida address attached; next one will be from the farm address. — **Warren J. Henderson**, Secretary, Fort Rock Farm, Drawer H, Exeter, N.H. 03833

34

News is rather sparse this month, and a fair bit of it the unpleasant variety at that. I am sorry to have to report the loss of two more members of the Class — **Edmond A. Chandler**, who died on February 14, 1975 and **W. Franklin Baxter, Jr.**, who suffered a coronary attack on January 31 of this year. In addition to his widow Mary, he also left two daughters, Jennefer Ann and Christie Isabel. To both families I would express our great sympathy on their loss.

I also received word that was really directed toward the class of '05 but also reaches into our class. **Art Manson, Jr.** wrote that his father, who graduated from the Institute in 1905, had died at the age of 92 this past January. Art said he had been mentally very active up to the moment of a



Ray Andrews (left) and Phil Kron, '34, in the back yard of Phil's house.

sudden fatal heart attack. We would sympathize with his loss but I am sure he draws comfort from the fact that his father was alert to the end.

Several Alumni Fund notes arrived — two distinguished in some degree by their cryptic nature. **Art Smith** says "Still warm and breathing: two big things going for me!" ... A little more loquacious, **Howard Sharp** writes, "Presently, management consulting; formerly, plant manager, American Chain and Cable and vice president and director of Insilco subsidiary in Taiwan, R.O.C."

Russell Hastings is pointing the way to the future when he notes, "Since the fall of 1973, all my spare time (and then some) has been occupied as chairman of the Metric Practice Committee of the American National Metric Council, which was organized in 1973 under the auspices of the American National Standards Institute to serve as a coordinating body for all portions of our economy that are involved in any way with the metric system. We have recently published a *Metric Editorial Guide* which is available from the American National Metric Council, 1625 Massachusetts Ave., N.W. Washington, D.C. 20036." Since our industry must head in this direction, the above address might be a good one to keep in mind.

From time to time we've noted the progress and promotions that have come to **Robert C. Guinness** who is now vice chairman of the Standard Oil Co. (Indiana). It has now been announced that he has been elected a director of the Champion International Co.

By the time you read this, Jane and I will be somewhere either in France or England, depending on when the May issue is published. It will be somewhat a repeat of the trip we made in 1973 — we don't know whether this is the year to be spending money or traveling, but we are sure that it won't take us any further next year, so we might as well enjoy it now. So the next notes may come from **George Bull** — if he has some to get out. I'll try to emulate some of the letters he sent on his past travels. — **Robert M. Franklin**, Secretary, Satucket Rd., Brewster, Mass. 02634; **George G. Bull**, Assistant Secretary, '4961 Allan Rd., Washington, D.C. 20016

35

Our 40th is going to be the biggest and best one yet. New registrations are coming in daily.

Past president of our class and good

friend **Walter Stockmayer**, Albert W. Smith Professor of Chemistry at Dartmouth College, is receiving more honors. Here's the latest: the 1975 American Physical Society High Polymer Physics Prize, sponsored by the Ford Motor Company. The prize will be bestowed at the March meeting of the Society in Denver. The citation reads as follows: "For his outstanding leadership in the development of the statistical mechanical theory of polymer solutions, leading to major contributions to the understanding on excluded volume, chain conformation and chain dynamics." A year ago Professor Stockmayer received the Peter Debye Award in Physical Chemistry of the American Chemical Society, sponsored by Exxon Chemical Company U.S.A.

Word belatedly reached us that a Course XV classmate, **John M. Teasdale**, died on Christmas Day in 1973. Phyllis Teasdale, John's widow wrote that she thought one of his classmates had passed this information along. We are sorry not to have known this before and send her our sincere sympathy. We hope she will be able to come to M.I.T. in June.

Three notes were passed along to us from the Alumni Fund Office. From **Kenneth Warren**: "Retired as assistant vice president, Allendale Mutual Insurance Co., Johnston, R.I., effective January 1, 1974. Every minute since then has been enjoyed doing what I wish and when I want to." . . . **Fred Tone** who will be at our 40th writes, "Am sorry to advise you that my wife Betty was struck by a car and killed last August. We have three sets of married children and six grandchildren in Holley, N.Y., Charlotte, N.C., and Daytona Beach." . . . From **Frank Hatch** in Burlingame, Calif., comes this quickie: "I retired from Shell Oil Co. in September, 1974 after 39 years, practically all in marketing."

And now the "pièce de resistance" — a letter from our just-resigned class president **Bob Forster** from Stockholm: "The first of February we moved (from two rooms in a hotel) into an apartment in a building four to five years old. It is on the top floor (7th). There are two saunas in the building. We have a western exposure off the living room with a roof deck. This will be very pleasant in summer. The weather has been mild without much snow, maybe an inch or two since we arrived. The coldest it has been is 12° F. . . . Our apartment is in a section of Stockholm comparable to Back Bay at Commonwealth and Berkeley. It takes 25 to 30 minutes to get to the office. My address is 48 Skeppargatan, S114-58 Stockholm, Sweden, Apt 7R. Last week I spent a day and a night in Oslo and later in the week a day and night in Helsinki. Big contrast — Oslo rather old and down, Helsinki quite progressive." I am sure that Bob would like to hear from you direct but I am going to keep him up-dated by sending him a copy of these notes each month. So share your letter with all your classmates by writing to Bob via me and win yourself a gold certificate, too. — **Allan Q. Mowatt**, Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

36

One bonus in being class secretary is that I receive copies of journals and bulletins which I would not usually see. I was fasci-

nated with the January 15 issue of "Science & Government Report" dealing with a possible new science advisory setup. In it **Bill Hewlett** is mentioned as a possibility for a major role. . . . **Boynton Beckwith** writes that he and his wife are traveling around in their spare time looking for a place in which to live after retirement. Being in Chicago with United Airlines, this is easier than it would be for many of us. He further remarks that he will miss not having access to weather data after forty years in the field.

. . . **Bob Gillette** has been re-elected a director of the National Life Insurance Co. of Vermont. . . . A letter from **Rufus Isaacs**, a professor of applied mathematics at Johns Hopkins, included a brief article on the first World Conference on Differential Games. His book on the subject was published in 1965. I have forwarded the paper to the *Review* editor at Rufus' suggestion.

Your secretary has been informed of the death of **Alden Anderson** of Lynn, Mass., in January. No further information is available. . . . Your secretary is writing these notes a few hours before the start of a five-week trip which, this time, will take her to the bottom of the Grand Canyon on foot. If I survive the climb back up you will hear from me again. — **Alice H. Kimball**, Secretary, P. O. Box 31, West Hartland, Conn. 06091

37

Bob Ferguson has moved from president of U.S.S. Engineers and Consultants, Inc. to executive vice president, engineering and research, U.S. Steel Corp. . . . **Berkey Bishop** writes, "My company was liquidated last year and I am now inactive. I still have a motel in Atlantic City and spend six months in New Jersey and six months in Florida." . . . **Milt Lief** is still with Nixdorff Chain Co. and he is on the board of directors of the Engineer's Club of St. Louis. Milt is also a certified manufacturing engineer, a member of the Engineering Committee of the National Association of Chain Manufacturers, and is chairman of the city of Olivette Land Clearance Authority, the Public Housing Commission, and the Citizen's Advisory Commission. . . . **Art Zimmerman** is vice president, contracts and material management of the Sifco Industries in Cleveland, Ohio. . . . **Dick Surbeck** is vice president of Operations Aviquipo, Inc., a subsidiary of Lockheed Aircraft Corp. He is also president and director general of Aviquipo in France and Belgium, and director of Aviquipo of Britain, Germany and the Netherlands. . . . **George Rosen**, Chief of Propeller Research, Hamilton Standard Division of United Aircraft Corporation recently received the Goddard Award, presented annually by the American Institute of Aeronautics and Astronautics for leadership and technical contributions in pioneering the development and production of widely-used turbopropeller propulsion systems. . . . **Bill McCune** has recently been made president of the Polaroid Co. — **Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, Mass. 02155; **Lester M. Klashman**, Assistant Secretary, 198 Maple St., Malden, Mass. 02148

38

Ascher H. Shapiro, Ford Professor of Engineering at M.I.T., has been appointed Institute Professor at M.I.T. in recognition of his contributions in fluid dynamics and in engineering education. The rank of Institute Professor at M.I.T. is one that is reserved for scholars of special distinction. . . . **Carl Feiss** writes "I am professor of architecture and urban studies and director of the Urban and Regional Development Center, University of Florida, Gainesville." . . . **Paul Arthur** sent a note: "John N. Ingraham retired as head of patent liaison group, Central Research Department, Du Pont Co."

I have received belated notices of the death of some of our classmates: **Edouard R. Bossange, Jr.**, Dec. 23, 1973; **Lloyd M. Hier**, May 31, 1974; **S. Charles Tsien**, Sept. 28, 1974; Mrs. **Virginia Marston Pierce**, Feb. 3, 1974. — **A. L. Bruneau, Jr.**, Secretary, Hurdman and Cranston, 140 Broadway, New York, N.Y. 10005

39

This month we all can bask in the light of glory reflected from **William H. Phillips** who was elected to be a fellow in the American Institute of Aeronautics and Astronautics. Fellows are persons of distinction in aeronautics and astronautics who have made notable and valuable contributions to the arts, sciences or technology in their field. Will's citation read: "For three decades of outstanding contributions to the science of aeronautics and space flight through leadership and technical creativity in the field of aircraft stability and control, and in the areas of guidance, rendezvous, navigation, and lunar landing for the Gemini and Apollo spacecraft."

Also honored at the same time was **Gordon E. Holbrook**, of General Motors Corp., who was co-winner of the coveted Goddard Award. Gordon is director of engineering and aerospace at G.M.'s Detroit Diesel Allison Division. The citation read: "For joint leadership and technical contributions in pioneering the development and production of widely-used turbopropeller propulsion systems." Our admiration and congratulations go to both of these high flyers.

Harold L. Smith, Jr., a vice president of Eastman Kodak Co., has been elected to the board of directors of Eastman Savings and Loan Association. Harold became associated with Eastman in 1939 and his career has included managing various divisions during these last 36 years. The news release did not divulge whether Harold could manage a loan for one or more of us, as he assumes his new duties, but interested individuals can write him to develop information on this topic. . . . **G. Arthur Morrell, Jr.** is with the Central Development Division of the Clark Equipment Company where he is contributing to improving noise control, product safety, and product design. . . . **Fred Gemmill** is managing business systems for his livelihood, and has an interesting outside activity. He is chairman of the Planning Board of the town of Hollis, N.H., and is surveying town property in preparation of the town property map. A note to Fred will bring an answer to your question whether there is similarity between what he is doing and what George Washington did 200 years ago.

And a note to me will be the easiest way

to let your classmates know about you. They are interested, and so am I. — **Hal Seykota**, Secretary, 14650 Island Dr., Jacksonville Beach, Fla. 32250

40

It is with regret I must report the death of Louise Walker Joseph, the wife of **John Joseph**. Louise was a member of the N.J. Art Association and was for many years chairman of the art department of the Hasbrouck Heights Women's Club. Donations in Louise's memory may be made to the M.I.T. Cancer Center in Cambridge, Mass. John is still president of Brrr Products, manufacturers of BLOCKBUSTER and management of real estate investments. His avocations are skindiving, sailing, chess and liberal politics.

John is one of the over 115 classmates who have indicated they hope to attend the 35th Reunion on June 6-8, 1975. If you plan to attend please notify Ted and Edith Kingsbury at 29 Rutgers Road, Wellesley, Mass. 02181 and send them a check for \$35.00. The check is refundable if you should cancel out. Room reservations should be made directly to Chatham Bar's Inn, Chatham, Mass. The tariff is \$86 per day per couple including meals, tax and tip and is payable when you leave. Before the reunion our class will be guests of M.I.T. in the dorms on June 5.

Tom Jones who at present is a visiting professor in engineering and education in the Division for Research and Education at M.I.T. has been elected Vice President-educational activities of the Institute of Electrical and Electronics Engineers for 1975.

... **Amos Joel Jr.** has been reelected President of the I.E.E.E. Amos has been with Bell Laboratories since 1940 and is presently a switching consultant. ... **Krome George** has been appointed Chief Executive Officer of the Aluminum Company of America. Of passing interest is that Tom, Amos and Krome all plan to attend the reunion. ... **Dan Puffer** writes that he is celebrating his 35th year with G.E. this year. He is manager of Thomson Labs in Lynn. He lives with his wife in Melrose, Mass., and his son is married and teaching and he has a daughter in New Mexico.

As a final item: while at Tech your secretary was talked out of running the Boston Marathon by Oscar Hedlund. Some 35 years later your secretary ran in the Washington Birthday Marathon on February 16 and finished 230th out of 397 starters. As he was the third oldest participant he was well satisfied. He was afraid to break 3 hrs., 30 mins. as that would have made him eligible to run in the Boston Marathon. Once in a lifetime is enough. See you at the reunion. — **Al Guttag**, Secretary, Cushman, Darby & Cushman, 1801 K Street, N.W., Washington, D.C. 20006

41

Here we go for the 5th consecutive month of '41 class notes: **Bob Lundberg** retired from the architectural firm of Haines, Lundberg and Waehler. (They were the original designers of the New York Times Tower in Times Square.) Bob has been responsible for the design of the A.E.C. Headquarters in Washington, D.C., the U.S. Army War College in Carlisle, Penn. and the P and G Corp. Headquarters in Cincinnati. He says

he is going to "concentrate on sailing Long Island Sound" and water color painting. Good Luck and Best Wishes! ... A number of members of our class have been elected to various councils: **George Vineyard**, Director, Brookhaven National Laboratory was elected to the Council of the American Institute of Physics. **Malcolm J. Abzug** was elected a Fellow of the American Institute of Aeronautics and Astronautics.

A note from **Robert Wallace Blake** that in 1974 he traveled to Kinshasa, Zaire, to renew the lease of Pan Am 747 to Air Zaire and to Rio de Janeiro on board Pan Am inaugural 747 flight to South America. In December he returned to M.I.T. to lecture in the Air Transportation Laboratory Seminar. ... In the aviation field our classmate **Joe Gavin**, Chairman of the Board of Grumman Aerospace Corp. had an interesting writeup in the January 19 Sunday *New York Times*. The Iranian loan based on 80 F-14s for \$2 billion and a large U.S. Navy contract helped keep Grumman's 22,000 workers and 10,000 subcontractors working. ... Send in all your news — I'm sure its fit to print — **Henry Avery**, U.S.S. Chemicals, 2863-600 Grant St., Pittsburgh, Penn. 15230

42

Harvey Kram reminds us that he is one of the class' grandfathers with two grandchildren — Nicole, age five, and Brent, age two. Brent, of course, will be in Course II, class of '95! ... Undoubtedly everyone has seen in the papers that **Robert Seaman, Jr.** has resigned as president of the National Academy of Engineering and became the first administrator of the new Energy Research and Development Administration. His first announcement was that if we do not all decrease our energy consumption there is no way to become self sufficient in the next ten years. I am sure we will all be following his activities closely. ... **Jerry Coe** sent in an article from the General Electric house organ "Monogram" about **Don Berkey** who is manager of advanced engineering for the G.E. Aircraft Engine Group at Lynn. Don received the prestigious Goddard Award in 1968 and was responsible for the development of the turbofan engine in the U.S. Airforce C-5 transport.

Have never seen class news at such a low ebb. It seems that all and sundry must be running around frantically drumming up new business in the current recession climate and no one has time to send in news. Sure hope to hear from all so please find time out from your crowded days and hurried weeks to drop a short note to me. Thanks a lot. — **L. K. Rosett**, Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

43

Gus Root dropped us a note, saying that he has been visiting throughout Appalachia for a policy analysis of the ATS-6 educational satellite launched in the spring of 1974. I would gather that he is still a professor of instructional communications at Syracuse University. ... **Klay Wilcox**, who was in the meteorology program with our class, updates us with news that he is a staff scientist with G.C.A. Technology Division of G.C.A. Corp. in Bedford, Mass., where he is in-

volved with problems of air pollution relating to the excessive use of the internal combustion engine. His first grandson arrived last November, thanks to daughter Barbara; his other daughter, Sandra, M.I.T. '70, is enrolled in the Medical School at George Washington University.

Last Sunday I telephoned class president **Ken Warden**, to see what's new. He told me that plans for an "off-year" reunion did not gel, but that the many Boston area alumni get together now and then. It appears that he meets with **Hans Walz** and **Ken Wadleigh** almost every week for refresher studies in some mathematical probability game involving pairs and three of a kind. With the above three hustlers in the game, how can the others stand a chance?

Frank Briber wrote me a short note with some very unhappy news for these notes. His brother-in-law, our beloved classmate **Howard P. McJunkin** died very suddenly of a heart attack at his home on March 8, in Charleston, W. Va. Howard was an officer of his family business, McJunkin Corp., in Charleston, distributors and fabricators of oil field supplies and equipment. He was very active in civic affairs, having served as chairman of the Charleston Urban Renewal Authority and as president of the Family Service Agency of Charleston. He was active at his country club, and besides golf, enjoyed flying and oil painting. The class extended its condolences to his family in West Virginia and to his sister, Anne Briber.

Edwin R. Lord passed away last September in Warwick, R. I. We had not heard about Ed for over twenty years, but many of us recall his gentle smiling presence in Cambridge those many years ago.

Your oh-so-stagnant secretary has been granted a four-week vacation for April, this year, and is going to see if Cape Cod is still there. So I may have some news about the Boston gang for the notes later this year. I am contemplating retirement in about ten years, and figured it is never too early to look for a snug harbor. — **Richard M. Feingold**, Secretary, 3757 State St., Santa Barbara, Calif. 93105

45

Your secretary feels like a midwife — a mid-reunion report based upon a mid-February telethon written in mid-March to be read by you in mid-May with fair-to—"mid-lin" information!

You all received your 30th Reunion mailing in early February and by the time Chairman **Gerry Quinnan**, **Frank Gallagher**, **Tom McNamara**, **Dave Trageser** and I called many of you on Tuesday, February 18, we had about 30 couples leaning our way. There is still plenty of time to join in; there is no need to add — the more the merrier!

In mid-February, **David R. Clare** was elected Vice Chairman of the Executive Committee of the Board of Directors of Johnson and Johnson. Dave will assume increased responsibilities in the management of J. and J.'s domestic and overseas companies. Dave joined J. and J. in 1946 as a supervisor trainee; 25 years later (1971) he became a director and member of the Executive Committee and in August, 1972, was elected Chairman of Johnson and Johnson Domestic Operating Co. as well as

the Baby Products Co. — quite a success story. . . . **Horace Wood, Jr.** advises that he is now with Management Recruiters in Nashua, N.H. — **Clinton H. Springer**, Secretary, Cranfield Road, New Castle, N.H. 03854

46

Sterling S. Bushnell is employed in the medical apparatus and equipment business. He reports they appear to be resisting the recession. His major task for this year will be to resist the type of governmental controls on medical and orthopaedic devices that are now imposed on the drug industry. This year is the introductory year for government controls on such devices.

John Maynard and his wife, Janet, are now grandparents for the fourth time. John and family have recently bought a condominium in West Palm Beach, Fla., for use as a vacation home but with rental out the other weeks of the year.

The American Institute of Aeronautics and Astronautics has recently elected **David S. Hoag** of the Charles Stark Draper Laboratories as a fellow in the A.I.A.A. It was awarded "For fundamental contributions in the implementation of vehicle guidance, and for program leadership in guidance system design and development, spanning two decades, from the Polaris to Apollo." . . . **John A. Knauss** has written an important article in the June, 1974 issue of "Science" titled "Marine Science and the 1974 Law of the Sea Conference." . . . **Ted Heuchling**, Vice President of Arthur D. Little Co. was runner-up in the first American Airlines Tennis Tournament at the Boston Harbor Tennis Club on February 13, 1975.

We regret we must report the death of **Gilbert J. Ahrens** of Titusville, Fla., on August 15, 1972. — **Russ Dostal**, Secretary, 18837 Palm Cir., Cleveland, Ohio 44126

47

As I write we are in the midst of a spring snowstorm which makes me really look forward to a week of golf and tennis at Hilton Head. Yes, this year we are playing tennis rather than skiing, primarily due to Bob's involvement with the high school hockey team. Received a nice note from **Howard Zwemer** which is as follows:

"Our big news is that we are about to depart for Germany where I will be director of operations analysis for U.S. Air Forces in Europe. Jane and I are avid sightseers and delighted with the opportunity. Our oldest son, Dirk, graduated from M.I.T. in chemistry last year and is now in graduate school at Berkeley. Number two son, Eric, is a junior at Princeton, and last but not least, Weare is a freshman at Dartmouth."

John Wittels has been installed as secretary of the O.S. Metric Association and is manager of engineering services with I.T.T. in Van Nuys, Calif. . . . **Edwin Lawrence**, after a long tour with G.E. is now with Rockwell in Pittsburgh and enjoying every minute of it. . . . **John Kellett** writes that after spending a four-week vacation in Europe he attended his 30th reunion at Phillips Academy in Andover. He then spent time on business in Japan and returned to Andover for his parents 50th wedding anniversary.

It was pleasant to hear from my old high school classmate, **Jim Bagnall**, who advises that since 1962 he has been a senior staff member at I.D.A. in Arlington, Va. In this capacity he is conducting studies on government military and civil systems. His daughter, Elizabeth, is graduating in June from M.I.T. with B.S./M.S. Son, Andrew, is a junior at Maryland and son, Joseph, a senior in high school.

I have been informed that **Eduardo Dibos-Chappuis** died in October of 1973. I assume that this was red-headed Eddie Dibos from Peru that played soccer and, as I recall, was a Chi Phi. Can anyone provide more information?

Had an enjoyable lunch last week with Dick Krueger, '46, who has moved back to Buffalo from Louisiana with Hooker. . . . Until next month, drop a line. — **Dick O'Donnell**, Secretary, 28516 Lincoln, Bay Village, Ohio 44140

49

Our mail service has been so slow and (worse) erratic between A.D.L.-Cambridge and A.D.L.-Rio de Janeiro, that I have decided to omit one column and to submit each manuscript for the next succeeding issue. I hope to regain my regularity of contact this way. Wish me luck.

From the Fund envelopes, nine notes: **John Alger** reports that his son Mont (for Montgomery) is enjoying Tech "especially because of the music courses and bands. The pass/fail grading for freshmen makes it hard to tell how he's doing, but he does seem motivated. Also, he and his friends enjoy my 1949 Voo Doo magazines." . . .

William E. Dennis retired from the U.S. Coast Guard in June of 1973 with 30 years service. Employed by "St. Louis Ship" as project engineer in September, 1973, he is now acting director of engineering. . . . **Herb Federhen** is "still working for the Advanced Research Projects Agency in Washington, mostly on communications-related programs." He has three children in college (M.I.T., William and Mary, and Oberlin), "costing more money than there is in the whole world." . . . **Fred Kagan** is "manager, C.N.S. Diseases Research with the Upjohn Co., Kalamazoo, Michigan."

Norman M. Klein appears to be fully occupied as Associate Partner, Skidmore, Owings and Merrill, Architects and Planners, Washington, D.C.; as visiting critic in architecture at Harvard Graduate School of Design; as professional lecturer in urban planning at George Washington University; and in consulting on transportation policy to the Office of Technology Assessment, U.S. Congress. . . . **Fred Landis** (M.E., '49) became Dean, College of Engineering and Applied Science, University of Wisconsin in Milwaukee, in August, 1974. . . . **Philip A. Lynn** reports (as of December, 1974), "Since January, 1974, I have been plagued by a series of heart attacks, each somewhat more severe than the other; culminating in open-heart surgery at the M.G.H. in November. I already feel like a new man and am looking forward to an early return to work. Fortunately, during all this period my employer, Turner Construction Co., has been constantly sympathetic, understanding and generous — so that my family and I have not had the added burden of severe

financial hardship. They are a great company to work for, and with." . . . **Walter E. Seibert, Jr.** joined the Chemical Bank in June, 1974 as a vice president technical of the petroleum and minerals division in New York City, to evaluate mining projects for financing and lending purposes. He has four in college this year! . . . **S. W. Williston Shor** retired from the Navy in July, 1973 after 31 years of commissioned service. He is now with Bechtel Power Corp. in San Francisco, where "my primary interest is in developing ways for us to increase the operating availability of the large power plants that U.S. industry has been building these past few years, so that we get more megawatt-hours per capital dollar expended."

Only one news release this month, from Muscatine, Iowa, announcing that **Virgil A. Minch** will "direct project management activities for Atlanta and the southeastern region" as vice president and head of the project group, Atlanta Division, Stanley Consultants, Inc.

Rio de Janeiro has almost recovered from "Carnival" and tomorrow, March 3, is back-to-school day for local schools. This will reduce weekday crowding at beaches and clubs, but will make sunny weekends more crowded until air temperatures fall 5 or 10 degrees (another month or two) — after which only tourists will go regularly to the beaches to swim, even though winter water temperatures are warmer than those in summer. Even with an active commuting schedule to Sao Paulo, I keep tanned enough to pass for a native. The tropics is where you "looks good but feels awful." Best wishes to all. — **Frank T. Hulswit**, Secretary, A.D.L. Acorn Park, Cambridge, Mass. 02140

50

Arthur E. Wolters is division technical superintendent for the manufacture of DuPont "Teflon" fluorocarbon resins and related products. His wife, Patricia, is an enthusiastic first-grade teacher. They have three children who enjoy the family 22-ft. runabout and 12-ft. sailboat. They live in Parkersburg, W. Va. . . . **Frederick R. Bentel** reports that Bentel & Bentel, architects A.I.A. of Locust Valley, was honored with five awards for design excellence of four of their completed buildings in 1974 by the New York State Association of Architects. The buildings are all located on Long Island. . . . **Norton Belknap** tells us that there is nothing new to report. As vice president-corporate planning of Exxon Corp., he has had a full year helping to wrestle with energy and economic problems, unlimited.

Robert A. Pucel has been appointed a consulting scientist at Raytheon's Research Division, Waltham, Mass. The position of consulting scientist is the highest professional scientific and engineering level obtainable at Raytheon. The designation is given in special recognition of continually outstanding research or engineering achievements over a long period of time. Dr. Pucel's latest studies have been concerned with the properties of the field-effect transistor, a new microwave semiconductor amplifier. He is the principal author of a book chapter on this topic in a reference volume to be published by Academic Press, continued on page 122

Massachusetts Economy: Sophisticated, but Foresight Needed



Albert J. Kelley, '48

What is the particular nature of the Massachusetts economy, where does it stand now, and in what directions should its legislators and inhabitants look?

The answer, says Albert J. Kelley, '48, Dean of the School of Management at Boston College, in a *Boston Globe* article of December 15, 1974: "Massachusetts has the characteristics of a mature industrial society in transition.

"When we pass through this transition, I believe that we are going to be a highly sophisticated economic society. But there are some terrible pains in going through this phase, and they're far from over."

Technology or Service Economy?

Historically, the Massachusetts economy has been technology-oriented — leading the nation in production of textiles, watches, ship-building, electronics, and computers. This kind of economy is termed a "high value-added business."

"For example, a handful of electronic parts costing a few dollars, to which some sophisticated technology and highly skilled labor are added, result in a product worth hundreds or thousands of dollars." Dean Kelley feels that "for most of its lifetime, Massachusetts has excelled economically by literally 'living by its wits.'

Engineers and skilled blue-collar craftsman are both crucial to this kind of economy. "While the engineer tends to be migratory, the skilled technician and craftsman have been a more stable factor in the Massachusetts economy and have been one of the strongest attributes of the labor force."

Another necessary characteristic is the "sophisticated financial community which has historically been risk- and venture-oriented... Many of our best known banks in Boston have provided a financial stability which has historically permitted our technology-based industries to grow over a period of years."

But now we are in transition to a service and cultural economy. Schools, insurance, consulting, financial institutions, and recreation attract people and money from all over the world, and these parts of our economy are advancing beyond once-primary manufacturing. Manufacturing is hindered due to tough environmental laws, high energy and transportation costs, and cutbacks in Defense Department contracts, without expansion of other federal programs.

Many are concerned with this trend and feel Massachusetts should maintain a high percentage of manufacturing industry and be concerned about becoming too service-oriented. Dr. Kelley disagrees; he argues that Massachusetts should do what it can do best — and to him that appears to be "sophisticated services for this nation and the rest of the world as well as development of technology-based products."

New Work Force

One of the biggest problems that Dean Kelley sees with the Massachusetts economy is the mis-matching of jobs with skills. A large segment of the state's population is becoming highly educated. This emphasis on higher education is depleting the work force of the middle-class blue-collar worker, "one of the major factors in the strength of our economy," whose children are now going to college. The effects of this are already visible in the shoe and metal industry where skilled metal and machine tool operator jobs are going begging.

"We're fast developing a two-tiered work force, a college-educated force and a marginal work force continually fed by immigration." More effort should be made to develop good trade vocational schools, which have long been neglected, says Kelley. Additionally, the narrow margin between welfare and unemployment benefits and the starting salary of less-skilled jobs induces people to lose interest in working.

Planning for the Future

"The important facts are our negative deviations from the national averages" — in employment, manufacturing income, and prices. Our goal should be "to reduce the

negative deviations so that, state-wide, we equal national economic figures, or at least take steps in the right direction."

The federal government has far more powerful effects on the Massachusetts economy than the state government. Federal fiscal policy determines the amount and cost of money available and federal policies also dictate the size of public programs and the kinds and sizes of grants. What options does the state have to affect its economic destiny?

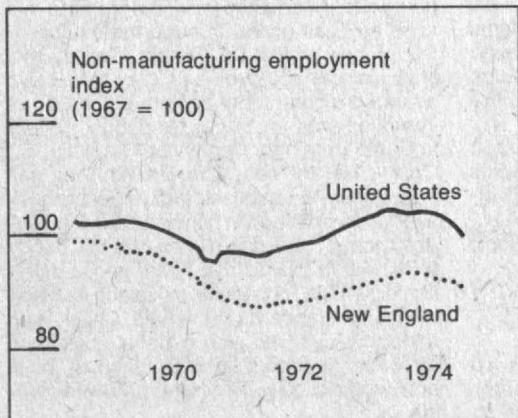
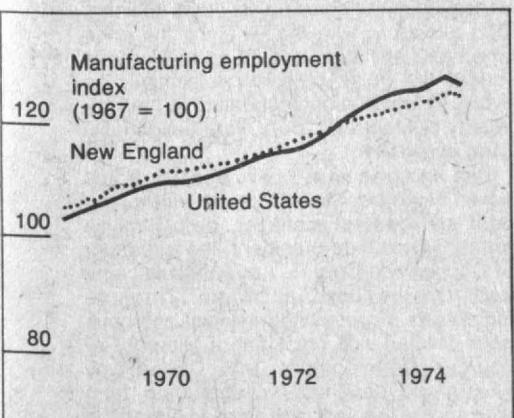
To answer that question, Dean Kelley looks analytically at the state's economy. State expenditures, the tax system, the economic and business climate, and jobs are in a "closed-loop feedback relationship." These variables have affected each other to cause a downward spiral: increased unemployment causes increased state expenditures and taxes on business, who in turn must lay off more employees to remain profitable.

To cure this spiral, state expenditures, which affect cost of living and the cost of doing business, must be kept at a modest growth rate. Kelley states that a master tax plan is essential to encourage the development of business activities. Coordination of taxes on state and local levels will prevent competition for the individual tax dollar. Business would then be able to make realistic plans based on projections of future expenses. Without a master tax plan "the resulting uncertainty will tend to discourage corporations and people from locating or remaining in the state."

Tax incentives may also be used to stimulate the business economy. Though this isn't a very strong weapon, it is one of the few under the control of the state government.

Massachusetts is one of the few states where the Department of Commerce and Development is not at the cabinet level. "This Department needs the support, the power, the visibility, and the salary structure to work with private enterprise and develop business and jobs in the Commonwealth."

A Master Economic Plan would be developed with maximum participation from not only state government, but citizens groups, business enterprises, and the public at large. "We should target the geographic areas that we want to develop, how we want to develop them, what industries we want to encourage, what resources will be required, and how the money will be raised." With such a Master Economic Plan the Massachusetts economy will no longer grow at random or experience sudden surprises. — Susanne Fairclough



New England has a decreasing share of the nation's manufacturing employment but a constant share of non-manufacturing employment. The transition in the northeast to a more service-oriented economy is attributed by Albert J. Kelley, '48, to the rising costs to business of transportation, energy, and taxes — and a more highly educated work force. (Data: Federal Reserve Bank of Boston)

a technical book publisher. He is the author or co-author of more than 35 technical papers and presentations in his fields of interest. He also has several patents in his name assigned to Raytheon. Dr. Pucel and his wife, the former Catherine Ann Silva of West Roxbury, and four of their children, reside in Needham, Mass. His son, James, is in the Navy.

Etto E. Von Zastrow has joined the General Electric Research and Development Center as manager of industrial and utility applications in the Solid State Power Center. He is a member of the Institute of Electrical and Electronics Engineers, and has served as vice chairman and transactions papers group chairman of its Power Semiconductor Committee. Mr. and Mrs. Von Zastrow and their five children will reside in Niskayuna. . . . **John H. MacMillan** has been appointed vice president of The Babcock & Wilcox Company's Nuclear Power Generation Division. He is married to the former Kathryn Richards of Cumberland, Md. The MacMillans have three daughters and reside in Lynchburg, Va. . . . **Gerald Peretsman** has been elected a vice president of Charter New York Corp., the holding company of Irving Trust Co. and 14 other New York State banks. Mr. Peretsman will serve on the staff of Charter's financial services group with responsibilities for planning and control. Gerald, his wife and two children reside in Great Neck, N.Y.

It is with sadness that we announce the passing of **Hans Kaarstein**, who died on February 22.

Charles H. Sherman, a physicist at the New London Laboratory of the Naval Underwater Systems Center (N.U.S.C.), has been elected a Fellow of the Acoustical Society of America. He is presently acting head of the sonar transducer division of N.U.S.C. Dr. Sherman began his career in underwater sound in 1953 when he joined the staff of the New London Laboratory. Within a few years he established himself as a leading expert in transducer radiation theory and array design. Early in his career he solved, for the first time, the mutual radiation impedance problem for a spherical array of transducers. He is the author of numerous reports and articles in professional journals. . . . **John T. McKenna**, Class Secretary, has been appointed vice president of operations for the Boston Gas Co. He is responsible for the administration and operation of the production and gas supply and planning departments, and all plant facilities. Jack is a former chairman of the liquefied natural gas committee of the American Gas Assoc. and a recipient of the Award of Merit of A.G.A.'s operating division. He is a member of the Society of Gas Operators and is a registered Professional Engineer in Mass. He and his wife, Dorothy, who teaches at the John Glenn Junior High School, have four children and live in Bedford.

We hope to see you and your families at the 25th Reunion on June 5 to 8. This is your last reminder — please make every effort to attend. — **John T. McKenna, Jr.**, Secretary, 2 Francis Kelley Rd., Bedford, Mass. 01730

51

Change is very much a part of the life we live these days and reviewing the notes from our various classmates this month in-

dicates that many of us are experiencing some very profound changes in our lives and lifestyles.

Dick Reuther has moved his family from Philadelphia to Moraga, Calif., where he has taken on the responsibility of Manager of Technical Services for the Flexible Packaging Div. of Crown Zellerbach Corp. This is after spending 20 years with Scott Paper Co., in Philadelphia as Manager of Plastics research and development. . . . **Glenn Mackey** will be looking at life from a different point of view. He has retired from the Air Force after 23 years' service and reports he is now relaxing in the San Antonio, Texas area.

John Mergenthaler is starting a second career after 16 years in the aerospace industry. He has decided to return to the chemical engineering environment of the chemical industry as a manager of the Chemical Engineering Research Section of Stauffer Chemical Co.'s Western Research Center in Richmond, Calif. . . . Another rather substantial change was reported by **Loring Lee** who has left Geophysical Service, Inc., after 21 years to start up a geophysical consulting service in Calgary, Alberta, specializing in Canadian Arctic explorations and North Sea studies. However, as a thread of continuity in this reporting of the ever-changing nature of our various careers, Loring reports also that his son David is a member of the M.I.T. Class of '76.

We had another note of the continuing interest of the alumni and their families in M.I.T. from our good friend, **Dave Caplan**. Dave's son, James, has entered the Institute as a member of the Class of 1978. Dave is still living in Framingham, Mass., with his wife, Ellie, and three daughters. Dave is a manager of engineering and programming for Raytheon Data Systems. They manufacture mini-computers and programmable terminals used by a good many of the leading U.S. and international airlines.

John Bergmann moved his family rather suddenly in September, 1974, to Pennsylvania where he is the Director of Technical Services for Acme Process Equipment Co. Acme makes equipment for the brewing and distilling industry, an industry I understand maintains its demand curve through recession, depression and what have you. As others have reported, this move represents a return in John's career and he is very pleased with the fact that he is now back primarily in manufacturing and engineering control. . . . **Tom Maddock** is president of Boyle Engineering Corp. He reports that the company has acquired new offices in Newport Beach that will consolidate all operations in southern California and will serve as corporate headquarters. Tom reports his company has grown through the establishing of new offices in Florida, Texas, and New Mexico, and overseas, they have been awarded a contract to design \$23 million of improvements for the water supply system in Santo Domingo, Dominican Republic. . . .

On the literary side, **Charles Whitney** has announced the publishing of his paperback sky guide entitled "Whitney's Star Finder." *Astronomy* magazine claims that this handy book with its plastic star finder is due to become "a bible for beginners" taking its place with other standards in the field. Chuck is an astrophysicist who won national acclaim in 1971 for *The Discovery of Our Galaxy*. He is now working on a biography of Edwin Hubble.

Our condolences to Carolyn **Hiester**. Her husband, **James**, passed away on November 20, 1974. . . . Our condolences to Mrs. **Benjamin Davidson** on the passing of her husband. Davidson died in December of 1968. Their last address was in the Bronx, N.Y. . . . Our regrets and condolences also to the family of **Patrick Griffin** in Ponce, Puerto Rico. Pat died December 2, 1974.

Those of us residing in the greater Boston area are very much aware of the architectural achievement of the Mall at Chestnut Hill. **Arthur Schein**, a partner in the firm of Sumner Schein, was responsible for the architecture as well as for other commercial and industrial projects here and throughout the country. . . . Operating a new department in our class notes, namely, Lost and Found, **George Thompson** writes that his class ring was lost at sea off the west coast of Mexico near San Blas. I hope Dr. Edgerton reads these notes and perhaps can help. At any rate, George is still professor of engineering at the Rochester Institute of Technology and assures us that he will learn Ohm's Law even if it kills him. I wonder if it's the learning or the teaching that may be more fatal.

Marty Miller is president of RPM Fashions, a manufacturing concern in the jean and jean shirt business headquartered in New York City. . . . **Roy Sachs** has asked for word from any M.I.T. graduate engaged in agricultural research, teaching or production. I know we have heard from classmates in the past and I hope anyone in these fields reading this particular report will contact Roy.

Finally, to end on a picturesque note, **Rolly Cann** writes from Springfield, Vt., from his 150 acres of wooded solitude. He is doing his part to reduce the trade imbalance by heating via a little stove in the kitchen using wood from his own acreage. As of the end of December he has not used his oil furnace but is candid enough to report that the cold weather has not really started. Reading our monthly heating bills we certainly have to envy him and wish him the very best in his quest for title of Number One Energy Saver.

Wonderful having this chance again to talk to all of you. The best of everything in 1975! — **Samuel Rubinovitz**, Assistant Secretary, 3 Bowser Rd., Lexington, Mass. 02173

53

Dear ole 1953ers: Your devoted secretary is now (slowly) recovering from his "official" housewarming (including six out-of-towners who moved in with me — since the price was right) and from a jaunt up to Montreal (under the guise of giving a seminar on urban transportation economics at the University of Montreal). Both were delightful!! (And expensive.)

Bits and pieces of news: **Ben Sack** just joined Roebling Steel Corp. as vice president and general manager, giving up his former job as vice president and a director of Copperweld Corp. . . . **Joan Mizer** came back from the "dead" and wrote: "I'm working now as a consulting geologist and have been elected vice president of Mineral Resources Development, Inc. Carlee, my 16-year-old daughter, will graduate from high school this year and plans to attend the

University of Wyoming next fall. Clay, my 15-year-old son, is a sophomore in high school and is more interested in finance than in science or engineering, but I'm still hopeful that he will be a third-generation M.I.T. student." (Oh, really now, Joan. Do all of our children have to be pressured into returning to dear ole "Tech is hell"!) . . . **Bob Piper** — who I run into from time to time, on one side of the country or the other, but never in the middle — dropped a line, noting: "As an early refugee from aerospace, I am currently working in transit planning in Vancouver, a large, pretty town whose natural charm is marred by the prohibition of good wine (at prices a refugee can afford). Objective is to learn what there is in system design and management to explain why more people ride transit in Canada than the U.S." (Bob, if you're still wondering "why," then why don't you start by buying a paperback edition of *The Urban Transportation Problem*, J. R. Meyer, et al., Harvard University Press?) . . . Hopefully, **Joan Mizer** will not shed tears when I announce that **James McKnight** has written that his daughter (Diane) will be graduating from M.I.T. this year with a major in Mechanical Engineering. . . . N.A.S.A. has announced that **Edward Flinn** has been named Director of Lunar Programs in the Office of Space Science at N.A.S.A. Headquarters, Washington, D.C. (His office is responsible for scientific exploration of the moon, involving analysis and interpretation of lunar data obtained from manned and automated space flights and planning of future missions.) Brother Flinn will also monitor activities of the Lunar Science Institute in Houston, Texas, operated for N.A.S.A. by the Universities Space Research Association, a consortium of 59 universities. (Okay, you aerospace research guys, you know where the bucks are and who controls them. So, good luck!) Prior to this position, Edward was (I think) technical director of Teledyne's Geotech's Alexandria, Va. laboratories where he was involved in research on detection and identification of underground nuclear explosions. Also, in the early 1970s, he was a visiting professor of geophysics at Brown University. . . . **Richard Ahrons** has joined Innotech Corp. as vice president, operations, in charge of the company's efforts to commercialize its Innotech technology, a new electronic material system. Previously, Ahrons was a vice president of Opcoa and earlier spent some 15 years with R.C.A., collecting some 12 patents in the process. (Frankly, guys and dolls, I haven't ever heard of Innotech or Opcoa either!)

Finally, **Bill Gent** took the trouble to write me a long letter about "the life and times of . . ." but I will save it until next month. Hopefully, it will give others the incentive to drop me a line. — **Martin Wohl**, Esq., Secretary, 7520 Carriage Lane, Pittsburgh, Penn. 15221 (Still!)

54

Mike Deskey is designing the United Nations Station for the New Second Avenue Subway in New York City. Mike, who has been with the architectural firm of Harrison and Abramovitz for sixteen years, reports that his household, besides himself, consists of three cats. . . . Another three-ring circus, without a cat act, is reported by Al

Dreyfoos who has expanded into television broadcasting from his other enterprises: electronics manufacturing and a color photographic laboratory. Al's new acquisition is Channel 12 in West Palm Beach, Fla., an affiliate of ABC.

Another entrepreneur, **Paul Valerio** has formed Paul P. Valerio Assoc. in Great Neck, N.Y., to provide structural consulting services. . . . **Hughes Associates, Inc.** — **Art Hughes** is president — provides engineering and management consulting in new product development, with emphasis on computer graphics. Art is the Delaware Valley's District Director of the Society for Information Display. . . . **Dave Springsteen** has joined the Corporate Finance Department of E. F. Hutton as vice president. . . . Two educators report: **Edward Craig** has been appointed associate dean of faculty at Union College, and **Harvey Amster** has been a professor of nuclear engineering at the University of California at Berkeley since 1961. — **E. David Howes, Jr.**, Secretary, Box 66, Carlisle, Mass. 01741; **Chuck Masison**, 96 Spellman Rd., Westwood, Mass. 02090; Lou Mahoney, 14 Danby Rd., Stoneham, Mass.

55

Twenty years. It's been that long since you graduated. A great deal has changed in that time, and you owe it to yourself to get together with old friends for some reminiscences, conviviality, and maybe some reassessment. They will be at the Harbor View in Edgartown, Martha's Vineyard, for the weekend after Alumni Day. Starting mid-morning, Friday, June 6, there will be buses from M.I.T. to the hotel. From then on there are parties, banquets, dancing, and buffets at the pool and other amenities until Sunday afternoon when transportation back to M.I.T. is provided. And all this for less than we told you before: the cost is \$130 per person with transportation from M.I.T., \$115 if you get there on your own. To encourage you to bring your family the price is \$35 less than above for each child staying in your room. It's not too late to plan to come. Send back the reservation form with a check or call Rick Morgenthaler at M.I.T. and work out the arrangements. But don't put it off. We'll be looking for you at the reunion.

Someone we expect at the reunion is our class president, **Dennis Shapiro**, who spent last November sailing a chartered boat around the Virgin Islands. Also planning to attend is Oswald Fuzzer, who has a new position. It was announced by J. Paul Graspy, President of National Grease and Sludge, that Dr. Fuzzer is the new chief engineer of Protein Power, Inc., the Seacucus-based subsidiary. Oswald will be in charge of harvesting broccoli nodules from the bottom of Hoboken harbor. The company ship, the Graspy Explorer, is under the direction of another alumnus, Horner Harechester.

John Lindenlaub, who is a professor of electrical engineering at Purdue University, was appointed program leader for technology transfer at Purdue's Laboratory for Applications of Remote Sensing. Last July, John and Debby spent three weeks in Europe. He visited several remote sensing organizations and presented a paper at the 1974 Frontiers in Education Conference. Also, John was elected to the position of

vice president of the I.E.E.E. Education Group. . . . **Harold Austin** holds the rating of master instructor in the physics department at Wentworth Institute in Boston, where he has been teaching since 1964. . . .

John W. Blake is presently the manager of environmental sciences at United Engineers and Constructors. He is involved in the licensing of construction and operations of fossil fuel and nuclear power plants from Puerto Rico to the state of Washington. His oldest daughter is now a sophomore in college, and his second daughter starts this year. . . . **Vladimir N. Chernyshov** is the manager of semiconductor operations at I.B.M.'s Essex Junction plant, where semiconductor memories are made for the corporation. This is twenty years in semiconductors for Vladimir — the first nine at Transitron, the rest at I.B.M. The Chernyshovs have five children, the latest being Alexis, one-year-old. . . . A late note from Roscoe Carsick again, the Armenian auto-repair tycoon, states that he intends to be at the 20th Reunion at the Harbor View in Martha's Vineyard so that he can get one of the neat souvenirs that will be there for each classmate. — **Allan G. Schell**, Secretary, 19 Wedgemere Avenue, Winchester, Mass. 01890

56

Well, only one year to go for the big package deal in New England — the class's 20th Reunion and the country's Bicentennial. . . . **Charles Berg** has resigned as Chief Engineer of the Federal Power Commission and has moved to Maine.

On a sad note, **William Hansen** died of a heart attack on January 24 in Washington. Bill had worked on weapons systems at the Washington Navy Yard. He is survived by his wife Norma and a son, Doran.

The annual **Mansperger** Christmas letter from Euclid was full of news of the family — the children growing in their school and summer activities, Bob now manager, research engineering at Warner and Swasey, more traveling, Pat in her church and civic activities, the summer vacation to Washington, D.C., visiting **Dave Hanson** in Binghamton on the way. . . . On the other hand, **Larry Moss** has joined the growing list of environmentalists working for Governor Brown in California. Larry is deputy secretary of the Energy Resources Conservation and Development Commission. — Cosecretaries: **Bruce B. Bredehoft**, Box 181, Dover, Mass. 02030; **Mrs. Lloyd Gilson**, 35 Partridge Road, Lexington, Mass. 02173

57

Here are some more notes on the people at the cocktail party in New York and some of the pictures that came out well are reproduced here:

Courtland Ross and his wife, Barbara, and their two children — Michael, five, and Nikki, three, are residing in Stamford, Conn., where Court has his own business specializing in computer simulation and forecasting services. . . . **Jay Bonnar** submitted the following biographical sketch: "After graduation in 1957 I spent three years on active duty with the Air Force as an engineering officer, having gone through

R.O.T.C. at Tech. Before returning to industry, I went back to M.I.T.'s Sloan School of Management and received an M.S. in industrial management in 1962. I started out my business career with Anaconda American Brass Co. in Waterbury, Conn., as a development engineer (one of my more successful projects being the silverless-clad dimes and quarters which are now so common) and later as research administrator. In 1969 I joined Handy and Harman as new products manager and am presently manager of the Brazing and Art Products Division. We are a specialty metals company and are principally involved with the processing of precious metals — silver and gold in particular. I have maintained contact with M.I.T. through the routes of the Alumni Club and Educational Council, having been president of the New Haven Alumni Club and regional chairman of the Educational Council. My office is in N.Y.C., so I am one of the "lucky" N.Y. commuters. I presently reside in Weston, Conn., with my wife, Carol, and three children — Chris, 16; Caroline, 12; and Brian, 8." . . . **Terry McMahon** provided us with the following: "Since leaving Tech and receiving my master's and doctorate degrees from Yale (in chemical engineering), I've been engaged principally in the automation and industrial control fields. Five years with I.B.M. in market development and industrial sales, two years as marketing manager of a start-up engineering contracting firm and, for the past seven years, as an independent engineering and marketing consultant (McMahon Technology Associates) with offices in New York. Two years ago, I was married to Rosemary Andersen whom I had met some years previously while we were both living in the same apartment building in Ridgefield Park, N.J. We now have a fifteen-month-old son — Timothy (would you believe Class of 1995) and are presently living in Palisades Park, N.J." . . . **Elliot Wolk** provided us with the following brief note: "In June, 1974, I resigned from Shearson, Hammill and Co. as first vice president and manager of the Block Trading arbitrage department and joined Bear, Stearns and Co. After initially working in the Block area at Bear, Stearns, I have now moved into the arbitrage department with institutional responsibility for trading in options and convertible preferred stocks."

A couple of New York classmates were unable to join us for the party but did send us some news. **Stanley Wand** sent us the following: "After graduating from Tech, I received my M.B.A. from Baruch School of Business and slowly drifted away from the straight engineering functions. After working as vice president — manufacturing of Slant/Fin Corporation in Greenvale, New York, and vice president/general manager for Wesco Industries (a division of Ingersoll-Rand); I finally "did my own thing" and bought a young, struggling electronic security company on Long Island. It has been a wild experience and, after the initial fear of losing (money and face), we have been able to keep our heads above water in spite of this lousy economy. I guess anything is possible if you are willing to work long hours and can take the aggravation. Competition from large companies is both impossible when it comes to laying out monies for marketing programs and no problem when it comes to running rings around sluggish giants." . . . And from **Hal**



*Top: Jordan Gruzen (left) and Roger Yasun;
Bottom: Elliott Wolk (left) and Andy
Blackman at '57 cocktail party in New York
in January.*

Shane: "Since September, 1968, I have been at the Baruch College of C.U.N.Y. I was elected chairman of the mathematics department in June, 1971 and re-elected twice since then. I was promoted to associate professor of mathematics in January, 1973. My first book, *Finite Mathematics: An Integrated Approach*, published by Charles E. Merrill, Inc. appeared last February. As for personal life, I am still married to the same woman, the former Mita Geltman and my two daughters keep growing up. Erica is now ten-and-a-half and Lisa is seven. We have bought a summer house in a homeowner's association in Lake Mohegan, N.Y., and I have just become financial secretary of the association (Cortland Colony, Inc.)."

Also from the mailbag are some notes that came with some Christmas cards. **Doug McIver**'s wife, Allegra, included the following note: "We are back in Washington where Doug is working long hours at the Federal Energy Office. I miss the warm weather, the flowers, and the hummingbirds of Santa Monica, but Mac, now five, can't wait for his first snowstorm!" . . . The **Mal Joneses** added on their card: "Hi — we moved to Denver last spring. I'm in charge of Data Processing Software Development for the United Banks of Colorado, a holding company with \$1 billion in assets and 16 banks. Come ski with us!!!"

I'm sure that both Mal and Doug, who along with me were members of Sigma Chi, as well as many other classmates, will be sad to learn of the death of **Henry ("Gub") Cutler**. I don't have any details other than that Gub was living in Jacksonville, Florida, and died in May of last year.

Finally, here is part of a letter from Gwenn Chorak responding to my letter on

Jim's death. "The children and I are happy for Jim for he did everything he wanted to and he accomplished his extremely high goals. We are deeply gratified that if he had to go, he went at home and I was with him, as he did do a great deal of traveling and he was to be in L.A. for some two-three weeks, scheduled to leave the day after he passed away. The children and I were able to get him out of Brazil the same day he went — a major accomplishment as Jim was it for the company here (now there's no one) — and back to Pueblo, Colorado. **Vern Porter** was at my side in Pueblo and made necessary arrangements for the minister there and **Jack Gibson** contacted his minister in L.A. for memorial services there. The children and I returned to Rio December 29, where we will remain until June 27. We, as yet, do not know where we will settle down. As Jim was in the process of getting an M.I.T. Alumni Club going here in Rio, we will be involved in this until we leave in June."

I have a lot of news for next month but I would appreciate letters and so forth from all of you. — **Fred L. Morefield**, Secretary, Apt. 6A, 285 Riverside Drive, New York, N.Y., 10025

59

Well, I really dropped the ball last month. The due date for the notes went by and I had a stack of replies and items to report. Notes on the back of contribution envelopes keep pouring in, resulting in a somewhat longer column than usual this month.

From the world of industry and finance, we heard from **Andrew De Stena** who was recently appointed projects director of the Process Plants Division of Foster Wheeler Energy Corp. in Houston. He has been with Foster Wheeler since leaving the Institute in 1959. . . . Moving north to news from Dallas, **Donald Spiller** is with the General Systems Division of I.B.M. as marketing manager. Though not in Dallas, he might have some interesting conversations with **Howard Ziff** who has been working on I.B.M.'s antitrust litigation (Telex vs. I.B.M.) at both trial and appeal. While awaiting further resolution from the Court of Appeals, Howard is engaged with personnel-related legal issues such as equal employment. . . . Also in Dallas, **Walter Humann** has two major responsibilities, having been re-elected (I thought all incumbents lost this past year!) vice chairman of the board of the Dallas Chamber of Commerce and having been newly appointed as executive vice president and chief operating officer of Hunt Investment Corp. which is involved in oil, gas, agribusiness and real estate.

Three to be added to the president circle are **George Haymaker** at Rea Magnet Wire Co., a subsidiary of Alcoa in Fort Wayne, Ind., **Calvin Campbell, Jr.** at Goodman Equipment Corp., which designs and manufactures underground coal, potash and metal mining machinery, in Chicago, and **Earl Rogers** at Precision Monolithics, Inc., manufacturers of precision operational amplifiers, digital-to-analog converters and other linear integrated circuits, in Santa Clara.

Other executives commenting on their activities were **John Brackett** and **Chuck Staples**. John is one of the founders, in 1969 (what a year to start!) of Softech and

currently serves as vice president and assistant general manager of the Systems for Management Division. John left the Institute staff to assist in the formation of this computer systems company which has grown to 70 employees in the last five years. Chuck has been unable to call an executive committee meeting of the class due to his "it's enough to keep me busy" activities as the general manager of the Multi-Tax Division and vice president of Finance of Standard Information Systems, Inc. (the new name of Call-A-Computer, Inc.)

Jonathan Weisbush sent a short note in response to our request to hear from more '59ers. He is now directing the activities of the Department of Correction Division of Health Services for the Commonwealth of Massachusetts and indicates that he is trying to stay in contact with the academic world as well. You didn't say where, Jonathan. . . . Another classmate on the Washington scene with **Bill Widnall** is **Roger Eiss** who has accepted a position as research assistant to Oregon representative AuCoin.

Returning from extensive travel is **Lynn Sykes** who was a member of the United States delegation for negotiation with the U.S.S.R. of the Threshold Underground Nuclear Test Ban in 1974 and then spent five weeks in China in October as part of the delegation on earthquake studies. . . . **Wesley Foell** has traveled to Vienna where he will spend the year as a visiting scientist in the area of environment-energy modeling at the International Institute for Applied Systems Analysis.

From the academic world, **Paul Todd** has returned to Penn State as associate professor of biophysics and chairman of the graduate program in genetics from a nine-month leave at Los Alamos working on radiation oncology (study of tumors) research. . . . Congratulations to **Charles Hill** who recently received the Polygon Award as the outstanding instructor in chemical engineering for the third time in the last six years. Charles, whose research interests are in the areas of membrane processes and spectroscopy of adsorbed species, did not indicate where he is teaching.

Congratulations also to **George Connor** who has recently been selected for promotion to lieutenant colonel in the army. George, who recently returned from a tour of duty at Johnston Island and participation in the Defense Systems Management School at Fort Belvoir, will now be at Picatinny Arsenal with Project Management Office for Munition Production Base Modernization and Expansion. . . . We also heard from Jean and **Chris Schlemmer** who attended the wedding in October of **Al Angelbeck** to Jeannette Moser in Hartford. Congratulations to Al, a laser expert with United Aircraft Research, and his bride.

Random notes from the backs of envelopes and formal press releases included the announcement by **Pat McGovern**, president of International Data Corp., that I.D.C. has established a new east-west trade program to provide market data and planning information to the computer, electronics and related industries interested in marketing its products in eastern Europe. Many may know of I.D.C. through its subsidiary, Computerworld. . . . New books include *A User's Guide to Enport-4*, by **Ron Rosenberg** and published by John Wiley. Ron is a professor of mechanical engineer-

ing at Michigan State. . . . Also announced by The M.I.T. Press is *How to Start Your Own Business*, an outgrowth of a series of nationwide seminars on entrepreneurship sponsored by the Alumni Association, which was edited by **William Putt**, another member of the president circle, with Holograph Corp.

Jim Conklin has been serving as associate director of the Northeast (Florida) Regional Data Center which provides instructional and research computing needs for the Universities of Florida and North Florida or, according to Jim, has a grand time trying to provide. . . . In response to the notes by **John Amrein** from the Chicago area, **Jim Snodgrass**, Director of Corporate Planning and Development for Esmark, Inc., "came out of hiding" and following his M.B.A. from the University of Chicago has forgotten most of the Course X "jazz." Jim has also inquired about **Larry Clawson**, **Joe Pedlosky**, **Mort Rubin** and **Frank Steward**, so let's hear from you.

Stop the presses! The following was received from **Adul Pinsuvana** in Bangkok just as the above copy was sent to press. Adul writes, "The '59er I see most often is **Narinder Saluja** who used to share an apartment with **George (Whiteman) Elbaum**. Narinder moved from his native Burma to Bangkok many years ago and now runs a very successful gem concern called Rama Enterprises at 285/15 Silom Road, Bangkok. His lovely wife, Carolyn, a graduate of Wellesley, teaches at the International School of Bangkok, the same school where my wife, Malulee, teaches.

"**Peter Yang**, '60, is in Bangkok (Thai name is Pitya Yangpichit), and runs a company called Grace Engineering at 191 Suriwongse Road in Bangkok. He is still single and shows no sign of enlightenment.

"Two Thai classmates are now living in the United States. **Apinan Dulyanai** works for I.B.M. and is living in San Jose, and **Subin Banharnsupavat** is a systems analyst in mechanical and nuclear engineering for Bechtel Power Corp. in Houston. I talked briefly with Apinan last December when I was in Los Angeles with a group of Inauguration Flight guests from Bangkok of Air Siam on its first DC-10.

"Last month (February), I had a reunion with **Bill Towle** who is stationed in India as a program management officer with WHO/SEARO (World Health Organization/Southeast Asia Regional Office) in New Delhi. Bill's address is 128 Malcha Marg, Chanakya Puri, 1, New Delhi. He has not changed much from his student days, except maybe a little bigger in the middle, a little balder on the top, in other words, just like the rest of us at the reunion.

"I am still working on the class reunion project in Bangkok sometimes. It may be more interesting in the future when we could plan a side trip to mainland China also. Anyway, I'll try to keep our classmates informed from our part of the world. Incidentally, if some of our classmates or any Tech alumnus comes through Bangkok, my office number is 516111 and I can be reached seven days a week. For those also in the Airline world, my SITA code is BKKXYVG.

"Enough for now, best wishes from the land of smiles."

Adul also noted that he had sent a commemorative publication of the 50th Anniversary of the American University Alumni Association in Thailand which has not yet been

received but which will be reviewed next month.

On a somewhat personal note, columns of this length are a pleasure to put together so let's hear from more of you. It only takes a short note to **Phil Richardson** at 180 Riverside Dr., New York, N.Y. 10024, **John Amrein** at 770 Greenwood Ave., Glenco Rd., Ill. 60022, **Bob Muh** at 907 Chantilly Rd., Los Angeles, Calif. 90024, **Adul Pinsuvana** at 49 Seri Road, Seri Village, Hua Mark, Bangkok, Thailand, or myself. — **Allan Bufford**, Secretary, 8 Whitney Rd., Newtonville, Mass. 02160

60

Donald L. Robbins was elected president of the Kansas City Central Paper Box Co. at the November, 1974 board of directors meeting. He had been the vice president and general manager since joining the firm in October, 1972. — M.L.

63

March — California. How different from March in Massachusetts. For most of you east of the Rockies it is still winter. Briggs field probably has patches of sooty snow lying here and there. The crew is still working out indoors, perhaps running laps up and down the stairs at Baker House. (Do they still do that?) But out here!! It's already spring. The hills are green and covered with vegetation. The air has been washed clean by the winter rains and you can see the mountains. . . . If you've never visited this part of the world you ought to — and I warn you, it's easy to become a convert. (Good grief, what corn!)

If any of you read the columns of other classes you may remember that Ron Gilman, previous secretary of the class of '64, gave monthly "class hero" awards to classmates who wrote him a letter. This month the class of '63 has one "class hero," **Steve Ditmeyer**, and one "un-class hero." I use the term "un-class hero" because one of my correspondents was a member of another class — the class of '64, in fact. And, with apologies to Steve Schlosser, current secretary of '64, I'm going to publish a letter from an old poker-playing buddy, John Meriwether, '64.

Steve Ditmeyer writes that he left the Federal Railroad Administration (part of the Department of Transportation) last summer, after spending six years working on the Northeast Corridor Project, Penn Central problems, and similar things. Steve is now with the World Bank, whose headquarters are also in Washington. He is a transportation economist in the Europe, Middle East and North Africa region, and he spends quite a bit of time abroad, dealing with the railways and port authorities in that part of the world.

John Meriwether, '64, sent a note from the Cornell University Arecibo Observatory in Puerto Rico. John spent parts of five straight winters in the Arctic, with trips to the North Pole and Northern Siberia, and is currently enjoying the soft Puerto Rican winter. He is working in the field of aeronomy — the physics and chemistry of the upper atmosphere. At Arecibo he operates the airglow observatory with a number of photometers and a six inch Fabry-Perot interferometer.

The experimental program measures the Doppler shifts of airglow emission lines due to neutral winds in the atmosphere at 300 km. John writes, "Looking back over the last ten years, I see what I am presently doing is highly removed from what I thought I would be doing when I left M.I.T. Nevertheless, the M.I.T. education made it possible for me to move at will in both fields of physics and chemistry. Had I to do it over again I would have liked to have had courses in electronics."

"I am married to a Ukrainian girl who is almost finished at the University of Maryland with her Ph.D. — then she will join me here."

Ron Walter is still Deputy Assistant Director of the Budget in New York City, trying to bridge the budget chasm. Marilyn is working 60 per cent as an attorney with the National Employment Law Project. Daughter Amy celebrated her first birthday back in January. . . . **Elliott Bird** took his wife and son on a trip to England and Holland last summer. In Holland he stayed in a little town called Breukelen (whence our "Brooklyn") where some mathematics meetings were held. Elliott presented a paper at the meetings. . . . Brigadier General **Charles Wilson** writes that he has been selected for promotion to Major General in early 1975. He has been reassigned from D.C.S. procurement and production, H.Q. A.F.S.C. at Andrews Air Force Base in Washington, D.C. to chief, special project office for static war H.Q., Supreme H.Q., Allied Powers Europe (more familiarly, SHAPE), Belgium, A.P.O., N.Y., 09055.

Vern Bremberg, was transferred from Mexico City back to New York City last summer. He is marketing manager in the Textile Fibres department of Dupont. This put a cramp in his scuba diving and underwater photography, but he is surviving the rigors of Manhattan living with yoga and long holiday periods back in Mexico. . . .

Oleg Fedoroff married Mary Jane Stasiev last July 6, and the Fedoroffs are now residing in Leavenworth, Kansas. (Not, I hope in that institution for which that city is famous.)

. . . **Peter Cleveland** graduated from Rush Medical College in Chicago and is interning at St. Lukes Hospital in Milwaukee, Wis. Pete's first child, a boy, was born August 22, 1974. . . . **Alan Marty** and his wife, Marie-Paule, announced the birth of a daughter, Victoria Anne on November 23, 1974. Dr. Marty is now chief of thoracic surgery at the Naval Hospital at Port Hueneme, Calif.

Frank Cocks visited universities in Australia and New Zealand during May and June of 1974, with side trips to the Great Barrier Reef, the Frank Josef, Fox, and Tasman glaciers, Wairakai geothermal area, and the glow-worms of Waitomo Caves. Frank also delivered a paper on phase diagrams at the International Conference of the Society for Cryobiology in London, during August. Sounds like you have covered a lot of ground in the last year! . . .

Raffi P. Yeghiyan has joined the staff of Kaman Avidyne, in Burlington, Mass., as an associate senior scientist, after ten years on the staff of the M.I.T. Aeroelastic and Structures Research Lab. . . . **Mike Lifschitz** is assistant professor of medicine at the University of Texas in San Antonio, Texas. . . .

John Grabowski moved this year to Glen-

cooe, Ill. John started in December as commodity manager for the grocery products division of National Can Corp.

Finally, it is with great personal sadness that I report that Joyce Conrad, the wife of **Bjorn Conrad**, was killed in a tragic automobile accident at Lake Tahoe on February 12, 1975. Joyce was a warm and open person. She will be sorely missed by those of us who knew her. — **Mike Bertin**, Secretary, 18022 Gillman St., Irvine, Calif. 92664

64

Greetings, '64! Class Hero this month is **Leslie Boring** who writes us from the desert. He is presently an account manager for foreign-based engineering and construction companies based in Riyadh, Saudi Arabia. Bud writes that he and his wife, Anne, are living in a residential compound of three houses where he was appointed compound manager. That job was given him because he is the only engineer living in the compound. He writes that it was a job he could have done without but it did improve his Arabic. The Borings send best regards to all the good folks around the Institute. For those of you who wish to write to them, the address is Leslie M. Boring, c/o First National City Bank, P.O. Box 833, Riyadh, Saudi Arabia.

Joe Kasper is completing an evening M.B.A. at Boston University this May. He also served as co-technical chairman of a navigation-related conference in Washington, D.C., last November. Joe has returned to flying as a hobby. At present, he is working on an instrument rating, and his wife Pat is working on a private pilot's license. They are installing a bent airplane wing-tip over their fireplace — that should be quite a conversation piece. . . . "Waves and Instabilities in Interplanetary Space" is just one of the papers **Joe Hollweg** has presented this year. He has also been busy vacationing. Last summer he was in Norway, and this winter found him in Guatemala. . . .

Ronald Randall now works for General Electric's Corporate Executive Staff after he left Maritime Fruit Carriers Shipping Co. He and his wife, Sally, have moved from New York City apartment living to a home on the Sound in Stamford, Conn.

The **Maury Shulmans** are expecting their first child in May. Maury is a systems engineer for I.B.M. in Philadelphia. . . . **John Timoshenko** still works for General Electric, but is now in the Materials and Processes Lab. He and his wife, Beverley, are proud parents for a third time. . . . **Jerry Weiner** is at present enrolled in the doctoral program at the University of Texas, Arlington, in Business Administration. He is currently President of the Fort Worth Jewish Community Center. . . . Kudos to my wife last month, as your continued class communications depended upon her. I have been busy scoffing up the meal money (casual overtime meal allowance) at R.C.A. as part of a general effort to get our plant on track again and rolling in the A.T.E. business. . . . Keep in touch. Visit, if you're near. — **Steve Schlosser**, Secretary, 15 Apple Hill Rd., Peabody, Mass., 01960

65

A word to start this month about **Tom Van Vleck**, a former neighbor. Tom never writes because he sees me fairly often and figures I have the data. So I do and I'll use it. Tom

was with the M.I.T. Information Processing Center until last spring — he left then to join the Honeywell Cambridge Information Systems Laboratory, the organization that develops the Multics Operating System. Tom worked on Multics at M.I.T. (from its beginning in 1965) and is now responsible for the storage system. About a year ago, Tom spent a month at the computing center of the major university in Rio de Janeiro, working with their students and staff. Tom has turned into a bit of a Brazil fanatic (I won't say Brazil nut) and spends some of his time scheming up ways to get back there. He is still single and his one extravagance is a Porsche 911.

While I can write up people I know and see, I mostly depend on letters and (especially) the Alumni Fund envelopes to assemble the column. Watch carefully . . . **Peter Addis**, '66, is a senior systems programmer with Honeywell in Billerica, Mass. Peter is pursuing a master's in computer science at Boston University and teaching FORTRAN in the M.I.T. high school studies program. He reports that the teaching is very rewarding and that power is having the M.I.T., B.U. and Honeywell computers at his disposal. . . . **Martha and Dennis Bekeny** had their "initial child," a daughter, Deirdre Esther, on September 9, 1974. Dennis is a chief resident in pediatrics at Yale New Haven Medical Center. . . . **Gordon Everest** received his Ph.D. in Business and Applied Economics from the University of Pennsylvania last May. His thesis on managing computer data resources is being revised and expanded and will be published in 1976 under the title *Database Management* by McGraw Hill. Gordon is now assistant professor at the University of Minnesota's Graduate School of Business Administration. . . . and **Mike Oliver** placed third in the two-mile race of last December's varsity-alumni track meet. (The alumi won.)

And that is it. Give my successor a good start. Write a letter . . . The reunion is cranking on. Lots of people coming. We are considering more space at the Museum of Science for the Saturday night dinner and dance. More news in the second mailing which should beat this column to your doors. See you all in June . . . Your secretary has moved to Lexington (just in time for the great bicentennial traffic jam) and bought a condominium (not by absconding with the class treasury, I fear). — **Steve Lipner**, Secretary (not for long), 15 Russell Sq., Lexington, Mass. 02173

67

Gordon DeWitte won the 35 lb. weight throw and placed third in the shot put as the M.I.T. alumni upset the M.I.T. varsity track team, 60-53, in last fall's alumni/varsity competition. It's good to see a man in shape eight years after graduation. . . . Nancy and **Richard Solomon** are pleased to announce the birth of their first child, Aaron Louis Solomon, on February 1, 1975, at 11:09 p.m.

. . . **John Rudy** writes that things have been very busy in Andover at Raytheon, one of the few large employers in the area in strong financial shape. John forwarded a copy of an article that **Ted Nygreen** had written for a recent issue of *InfoSystems*. Ted is director of management information systems for the National Broadcasting Co. in New York City. . . . **Jeff Dodson** asked

me to place the following in our class notes: "Does anyone know the whereabouts of Gary Sherman, '68? Mary and I got married August 9 (same day Nixon resigned)! I graduate from Harvard Dental in May. We move out to Seattle in June forever. Classmates will be warmed to hear that 'Bite the Fuzzy Wa-Wa' still lives in the Building 7 Mens Room!"

Ed Geltman is on active duty in the Air Force and is stationed at Sheppard Air Force Base, Texas. . . . Perhaps the note from **Jeff Schoenwald** should appear in "Puzzle Corner." As one of a dwindling number of bachelors in our class, Jeff wants to know what the critical conditions are for a change of marital state. . . . **J. Antonio Marquez** has been appointed co-chairman of the El Paso District for National Children's Health Week and will make spot appearances on local television for promotion of dental health for children. . . . After post-doctoral work at Oxford and the Institute for Advanced Study in Princeton, **George Sacerdote** is on the faculty at Amherst. . . . **Charles Greene** writes documentary film scripts in Toronto and spends his spare time stripping paint off his farmhouse and furniture purchased at country auctions. — **Jim Swanson**, Secretary, 669 Glen Road, Danville, Calif. 94526

69

We're low on letters this time, but here goes:

Daniel Benn writes that he is still alive and well in Montreal, Canada. Dan is working on pulmonary research at McGill University's Meakins-Christie Laboratory. He can be reached by post at: 3775 University St., Montreal. . . . **Mark L. Braunstein** received his M.D. degree in June, 1974, from the Medical University of South Carolina in Charleston. He is interning at Barnes Hospital, St. Louis, in internal medicine. Mark is returning to Charleston in July to direct the development of a computer-based medical record system he began as a medical student. . . . **David Chanoux**, '68, writes that he received an M.B.A. from the other institution up the river in 1971. Twin girls were born to Judie, his wife, on August 8, 1969. David is now a product representative for I.B.M. on the System 7. Judie graduated from Stonybrook University in Sociology. The girls, Kate and Valerie, have started school.

George C. Slusher, U.S.A.F., will be transferred: (by the time you read this "has been transferred") in March, 1975, to Luke A.F.B., Phoenix, Ariz., to work in the Tactical Air Command's logistic engineering detachment. George's group is new and will be working with the F-15 Eagle in its initial deployment. . . . **Charles M. Spooner** is living in Acton, Mass., and is director of the Massachusetts Commission on Nuclear Safety.

John F. Straitz III, was recently promoted to the position of director of pollution control division at National Airoil Burner Co. in Philadelphia, Penn. John is responsible for the design and application of pollution control equipment used in oil production, refining, offshore drilling, and oil spill disposal. He has received over 40 U.S. and foreign patents on his design.

That's all for now folks. Do keep those letters and postcards coming. Look forward to

reading more of the thrilling exploits of the class of '69 in next month's edition of *TR* at your newsstands soon. — **Peter Peckarsky**, Secretary, 950 25th St., N.W., Washington, D.C. 20037

71

We'll start this issue's class notes with a question: **Paul Snover**, class secretary who should be doing the class notes, where are you?

We were in Boston a few months ago and saw: **Lee Scheffler** —working for Honeywell; **Steve "Papa Duck" Ehrmann** — grad student at the 'Tute; **Betty Deakin Bennett**, '70 — working at the 'Tute and finishing her law degree; **Cathy Buckley** — working at the 'Tute and singing "Mack the Knife"; **Linda Getch Shaw** — going to Switzerland to become a Transcendental Meditation teacher; **Janet Koch Rossow** — grad student in Civil Engineering at the 'Tute; **Peter Rossow** — grad student at Harvard; and **Andi Sanders** — who prefers to remain anonymous.

Classmates still in school, as teachers and/or learners: **Michael Pustejovsky** is still a grad student in aero and astro. . . . **Robert Hander** is at New Jersey College of Medicine at Newark after spending most of his summer traveling across the U.S. and Canada. "People in California don't understand how I can survive New Jersey; all I can answer is that people are incredibly adaptive." . . . **David Meharry** said we grossly misspelled his name last time (sorry) and wrote: "I am still living, working, studying, and singing in Finland. Work and study at the Radio Laboratory of the Helsinki University of Technology (research assistant — teaching assistant — licensiate degree almost finished). Living 13 km. west of Helsinki with wife Marja. I also sing in three different choruses in and around Helsinki." . . . **Robert D. Marshall, Jr.**, is at Georgetown University Law Center in Washington, D.C., living in Arlington and commuting by bicycle. "Law school isn't bad yet but all my exams are next June for nine months of school. Still keeping in shape and playing IM football."

John Stefano sent a note saying "I would like to announce the birth of my first child, a girl, named Jade Ara, on December 12, 1974. I will be graduating S.U.N.Y. at Buffalo School of Medicine this coming June and will be going on to a year of internship at Beth Israel Hospital in N.Y.C. This will be followed by a residency in ophthalmology at the same." . . . **Nancy Greene Burstein** sent a letter saying "Philip and I have been married for a year and a half now. We both hope to get our Ph.D.s in economics from Yale this summer. In September we migrate to West Lafayette, Ind. We will both be assistant professors in the Krannert School at Purdue. It's a bit of a shock." . . . **John T. Reed** sent the following cryptic message: "Initiated into Phi Kappa Phi Honor Society." . . . **Harold Ting** is in the Engineering-Economic Systems Dept. at Stanford University and expects to complete his dissertation for a Ph.D. at the end of March. . . . **Glen A. Brunk** is a student at the Indiana University School of Medicine and was elected to membership in Alpha Omega Alpha, honorary medical organization.

Now for classmates out in the real working world: **Grethe B. Holby**, is pres-

ently a member of the well-acclaimed Laura Dean and Dance Co. in New York. . . . **Lester Byllington** has been employed by General Dynamics/Pomona Division since graduation, doing primarily advance development work on guidance computers for tactical missiles, and became a senior engineer after two years. "Outside of work I have been climbing actively in the Sierras, with one trip to the Mexican volcanoes."

. . . **Timothy M. Bradley** '73, is self-employed as an architectural draftsman working toward an eventual architectural license in Hawaii. . . . **Jay Goldman** graduated with a B.S. and M.S. in June, 1973, and began work at M.I.T. for the Programming Development Office. He is part of a group which is developing a relational data management system. . . . **Gary L. Urbanek** was promoted to Captain in the U.S.A.F., working in the Air Force's System Command, which is responsible for all A.F. research and development. He is stationed at Andrews A.F.B., Md.

Gustavo Benedicty sent us a letter saying "After graduation I spent a year touring Greece and Italy, enjoying the food, the scenery and the student riots and learning Egyptology at the University of Florence. The following year I enrolled at Stanford University and married Amy Gunther (Wellesley '72). After getting my M.S., Amy and I decided to move to Colorado, where I work for Hewlett-Packard as a process engineer in the I.C. facility. Thanksgiving '73 a daughter, Alessandra, was born to us. We spend most of our spare time outdoors enjoying the mild, dry climate of Colorado, and tending to a vegetable and rose garden and a few fruit trees." . . . **Richard E. Stat** moved from Connecticut, where he was working in the Treasurer's Dept. of G.T.E. back to his home town of Wilmington, Del. He's currently developing and applying computer systems for a local company, Pan American Chemical Corp. . . . **Mrs. Alexandra Zakak** is working as an engineer for Walden Res. Div. of Abcor Inc., located in Cambridge, and has a three-year-old girl. . . . **Ashok B. Boghani** is working for Foster-Miller Assoc. Inc. as a staff engineer.

Classmates doing both: **Bill Lee** sent a note saying "I am alive and well. At the moment I am working at the Draper Labs (it's hard to get away from this place) and going to law school at night — which takes care of both my spare time and spare money." . . . **Dwight A. Davis** '73, is currently working on an M.B.A. in finance and marketing at the University of Cincinnati, as a part time graduate student (night classes). "At P. & G. I completed my initial assignment in the Prell Process Development area and am now on the New Shampoo Product Team." . . . **Alan P. Daurio** is working as a guidance software analyst at TRW Systems Group in Redondo Beach, Calif. He is taking night classes at California State College in Long Beach to obtain a certificate in urban studies.

Then there are the miscellaneous comments: all **Keith Price** told us was: "Rather normal year, **Jim Ward** and I took a short drive up to Alaska this past June." . . . According to **Marc Covitt**, **Marc Barman** married Joyce Bernstein in June. . . . **Nancy (Liebman) Rosenfeld** and Don (her husband) are living in Stony Brook, N.Y., and are the proud parents of a daughter, born in August. Don is teaching at S.U.N.Y. at Stony Brook and Nancy is working part-time

as a computer programmer.

We're sorry to report the death last May of **Richard A. Ziebelman**; he was in an auto accident in Bolivia while working on his thesis in anthropology.

Last, but not at all least, is the letter from **Corey Probst**. "I received my M.B.A. from Queen's University in Kingston, Ontario in May, 1973, and went to work for the Hartford Insurance Group in their Operations Research Dept. in Hartford, Conn. Worked there for six months. I am now working for Bliss and Laughlin Industries, a small, diversified company, in Oak Brook, Ill. One of my associates at the Hartford came here as the Manager of Management Systems and offered me the chance to start my own Operations Research Dept. here at B.L.I. Currently, I am the only member of the department and it presents quite a challenge. Thus far I've worked on setting up both a standard cost system and a machine scheduling system for our Steel Group. In addition, I've been working on financial models for the divisions. It looks like Maureen (wife) and I are finally settling down now. We bought a house in Bollingbrook, Ill., last May and are very happy. I am currently trying to become active with the Educational Council again. If any of my classmates are working in the Chicago area I would like to hear from them."

Corey gets the Class Notes Contributor of the Issue Award. Please follow his example — it would make producing long and frequent class notes much easier for us. — **Howard Jay and Leah Jamieson Siegel**, Class Officers, 228C Harrison St., Princeton, N.J. 08540

72

Bob Goodof writes, "I am now working for the 'almighty Dow Chemical Company' in Midland, Michigan, overseeing a mechanical properties lab testing new plastic materials and designing with plastics. Despite Dow's controversial campus reputation I've found it to be quite fair and conscientious. My M.I.T. hobby of goal-tending on frozen January nights has continued on a twice-weekly basis in Midland. Although single and inclined to remain that way, I've bought a house in the country with a triangular living room, and multi-sided bedrooms reminiscent of Baker 'couch singles.' I've been here a year and a quarter and I don't miss school a bit, although the social life of a conservative company town can be sedate at times — mighty sedate."

Steven Henry reports, "After completing my master's in E.E. at M.I.T., Carol and I moved to Washington where I am a student at Georgetown University Law Center. Last summer I was a legal clerk in the N.A.S.A. Office of Patent Counsel. Then I joined the firm of Mason, Fenwick, and Lawrence, where I am learning the practice of patent, trademark, and copyright law. I also write for *Law and Policy in International Business*, Georgetown's international law review. Since we have been in D.C. we have been visited by **Paul Magerl** on his way to Europe, and **Paul Hirsohn**. Occasionally we get together with **Steve Clarke** and his wife, Aida (he's at the University of Maryland) and I frequently see **Joe Kashi** at the law school."

A few short notes: **Gary Chirlin** is a biological systems analyst at the Smithsonian Temperate Zone Estuarine Research

Lab on the Rhode River in Maryland. . . . **James Carr** was married last August to Marcia Dixcy in Greenwich, Conn., became a registered architect in New York last June and is working at the Eggers Partnership in New York City. . . . Jerry Fly, '73, returned to the Institute this fall with his wife Penny and their two-month-old (at the time) baby.

. . . **Betty Hutchins** and Samer Khanachet, '73, are at the Harvard Business School. . . . **Ken Kempson** was commissioned from Naval O.C.S. and is at Supply School. . . . **Becky Donellan** is in her last year at Harvard Law. . . . **Ric DiCapua** is at Harvard Business School. . . . I am informed that **Chip Kimball** owns a house in Auburndale together with Rich Heldt, '67, and the Newton Savings Bank, and that he "moves dirt" for the Kernwood Construction Company in Waltham. . . . **Marta Berghofer** is teaching English to new Canadians in Vancouver, while her husband, Dave, '71, has completed a master's in high energy physics at the University of B.C. and is working on a Ph.D. on the TRIUMPH project there. . . . **Richard White** has been named administrative assistant in Governor Dukakis's press office. He designed computer systems for Inforex in Burlington before starting the new job.

Kathy Swartz wrote to say, "I passed my last qualifying exam so that now I am a Ph.D. candidate in economics at the University of Wisconsin in Madison. My other news is that in June, Frank Levy, '63, and I are getting married. Frank is an associate professor of economics at Berkeley so I am working on my dissertation in California. I hope to be finished in June 1976 and then teach." . . . **Darrel Riegel** writes, "I was married last August to a Simmons girl (another statistic!). I'm now at George Washington University Med School getting an M.D. and trying to get involved in computer aspects in medicine." . . . **John Nuetzel** is at Berkeley finishing his Ph.D. in physiological psychology. . . . **Lanning Penn** is in the Navy stationed at the Philadelphia Naval Shipyard.

And now for the sports news. We have it on the good authority of *The Tech* that the alumni "upset" the varsity track team last fall by 60-53. Albert Lau, '73, led all alumni scorers with 14 points, winning the broad jump and placing second in three other events. It rather strikes me that the undergraduates who write *The Tech* were a bit unfair in calling it an "upset." We may be alumni, but we still can manage a few things. — **Dick Fletcher**, Secretary, 135 West St., Braintree, Mass. 02184

74

On February 2, 1975 at 7:15 p.m. I received a visitation. And who was it who rang the doorbell at this early hour of the night? It was **Van Dunn**, our class vice president. Van is currently attending Stony Brook University in a joint M.D. - Ph.D. (biochemistry) program. He misses the excitement of the Boston-Cambridge area — Stony Brook is out in the middle of nowhere (i.e. Long Island, N.Y.). Van also mentioned that he has received a letter from **Ted Shifrin** who is enjoying University of California at Berkeley. Ted is studying mathematics at Berkeley's graduate school.

Marty Davidoff, our class agent, is engaged to Sheila Tempkin, a teacher and former graduate student at Simmons Col-

lege. They plan to get married in a year from June. Marty is expecting his master in business administration from Boston University this August. He plans to go to law school afterwards.

Marty recently received a letter from **Derrick Vlad**, our class president. Derrick is in his first year at the University of Chicago Business School. He says the program is good, but "the social life here isn't so great, though." Other members of our class attending the school with Derrick include **Stan Kubiak**, **Steve Harris**, **Joe Fernandez**, **Dan Foley**, **John Edwards**, **Jean Beinoir**, and **Hon Kwai**. Derrick has not met all of them, but he plans to.

Charles Calhoun is married as of June 22, 1974 to Terry Ann Seldon of Simmons College, class of 1974. Their honeymoon was in the British Isles for six weeks. . . .

Steve Gould is working for Johnson Controls in Woburn, Mass., as a sales engineer. They specialize in controlled environments for computers and offices. . . . **Bill Donner** is working for Digital Equipment Corporation as a software instructor — "teaching courses on the DEC I/O operating system and traveling a bit. Enjoying the quiet life in the suburbs but looking forward to returning to the Institute." . . . **Robert Nance** writes that he is a "freshman (again) at the University of Miami School of Medicine." . . . **Mark Mazak** is a student at Harvard School of Public Health in a two-year master's program in health services administration. . . . **John Plum** is "counseling many members in the commercial bank management program at Morgan Guaranty."

Dennis Mill, '73, is working with **John Tierney** as an actuary at Commercial Union Assurance in Boston. John is an actuary as well. I met John and **Jim Gokhale** on my way to an M.I.T. Lecture Series Committee movie. I just cannot avoid the hotspot of Cambridge social life. — **Dennis Dickstein**, Secretary-Treasurer, 23 Howard St., Cambridge, Mass. 02139

Notice of Election for Representatives from Recent Classes to the Corporation

If you received an undergraduate or graduate degree in 1973 or 1974 or expect to receive a degree in 1975, you are eligible to vote in this special election for the Corporation. One of the following people on this year's ballot will be elected:

Charles Collins, '73
Shirley Jackson, '73
Andre Jaglom, '74
Storm Kaufman, '75
Peter Marcuso, '75
James Moody, '75
Barbara Moore, '75
David Wilson, '73

If you have not received a ballot and are eligible to vote, please call or write the Alumni Association, 253-3768. All ballots are due by May 15. Please, vote.

An article, "New Directions for our Cities in the Seventies" by Alexander Ganz and Thomas O'Brien, in the June issue of Technology Review has given me a concise and lucid understanding of the direction of urban redevelopment. I hope to obtain permission from you to reproduce approximately 100 copies for distribution to the registrants at our upcoming seminar.

In accordance with permission granted in our telephone conversation today, we are proceeding to reproduce your publication, "Energy Technology for the Year 2000," for internal use in our continuing education program.

The IEEE Engineering Management Society publishes a reprint journal entitled IEEE ENGINEERING MANAGEMENT REVIEW, for distribution to its own members. The editor, Dr. Irwin Gray, has selected some material from your publication that he would like to include in forthcoming issues.

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Ray Jaeger wants to make light of phone calls...

by sending them through tiny glass fibers on beams of light pulses. To this end, Bell Labs ceramic scientist Ray Jaeger has helped design a new system to make such fibers — using a powerful carbon dioxide laser.

In the future, one hair-thin fiber might carry several phone calls within big cities or as many as 4000 long-distance calls. But many problems must still be solved. Ray tackled one of them — the problem of today's glass fibers, which contain impurities that absorb and weaken light beams. One impurity source is the conventional heaters used to melt glass rods that are drawn into fibers.

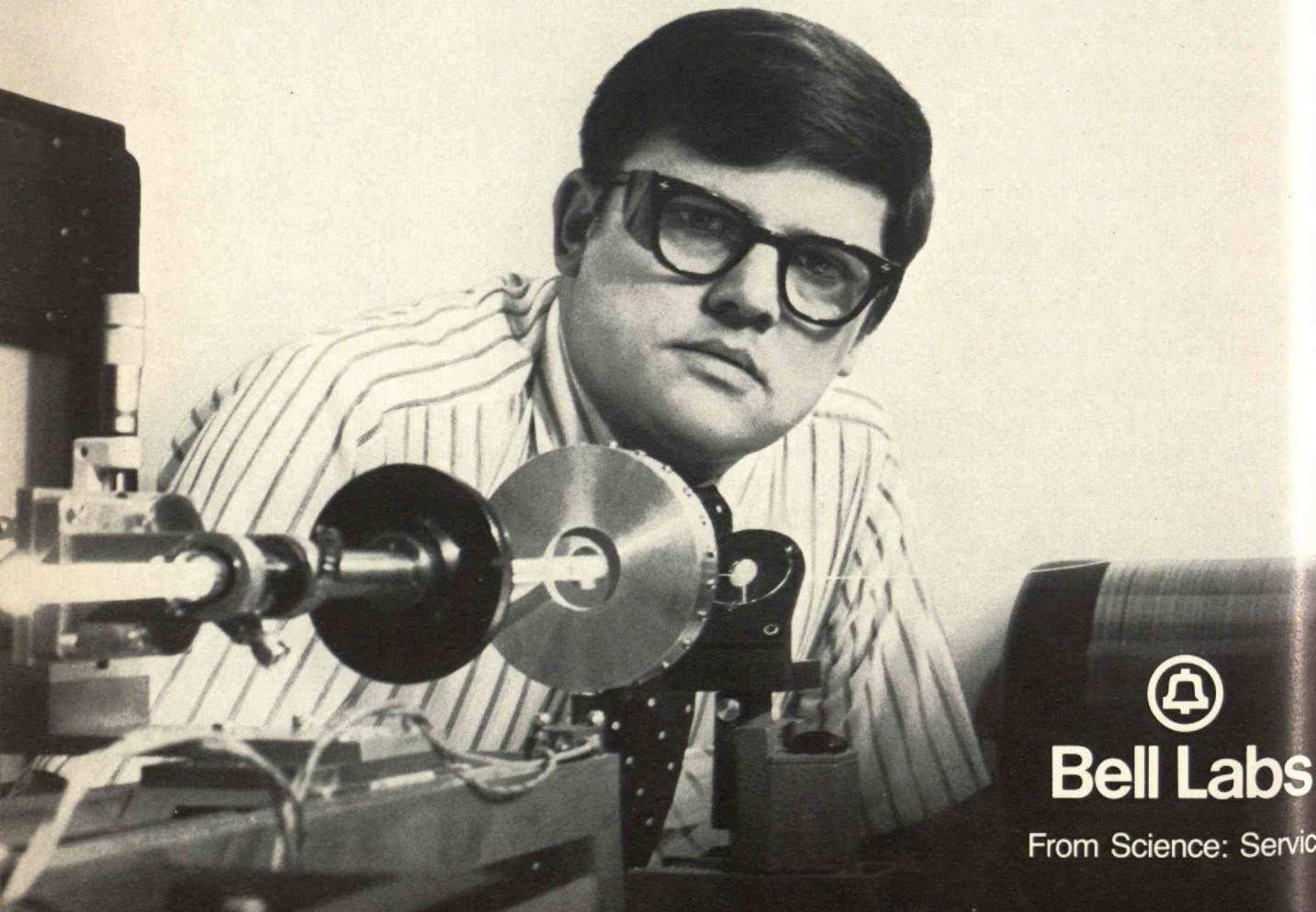
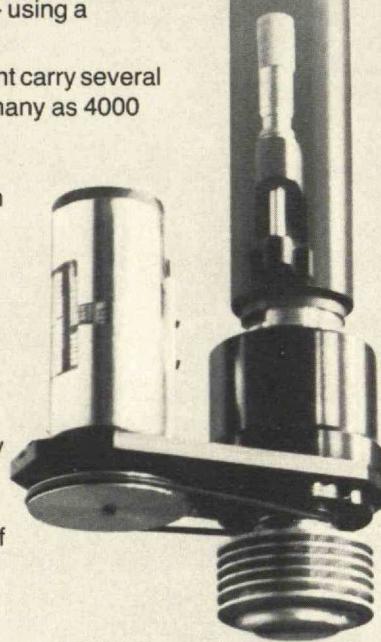
Ray had to find a "clean" heat source that also would be precisely controllable, to assure uniform diameter throughout a mile-long fiber. Using his broad knowledge of ceramic materials — he's a 1967

ceramic science Ph.D. from Rutgers — Ray studied many heat sources. But he finally explored a new approach: melt the glass rod with a carbon dioxide laser.

To make fibers, Ray had to devise a way of focusing the laser beam uniformly around the rod's circumference. He solved this major problem with a rotating lens and reflectors, to form a doughnut of radiation around the rod. Now Western Electric engineers are studying variations of such a laser system to develop the most practical manufacturing procedure.

To make optical communications useful, other Bell Labs scientists are working on ways of splicing glass fibers. And on better, cheaper longer-lasting light sources and efficient ways of getting calls on and off light beams.

Although today's communications systems are more than adequate, someday there will be a need for the added versatility and capacity of optical systems. And the Bell System will be ready because of Ray and others like him.



Bell Labs

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